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Slime Treatment and Electrolytic Precipitation at Inspiration

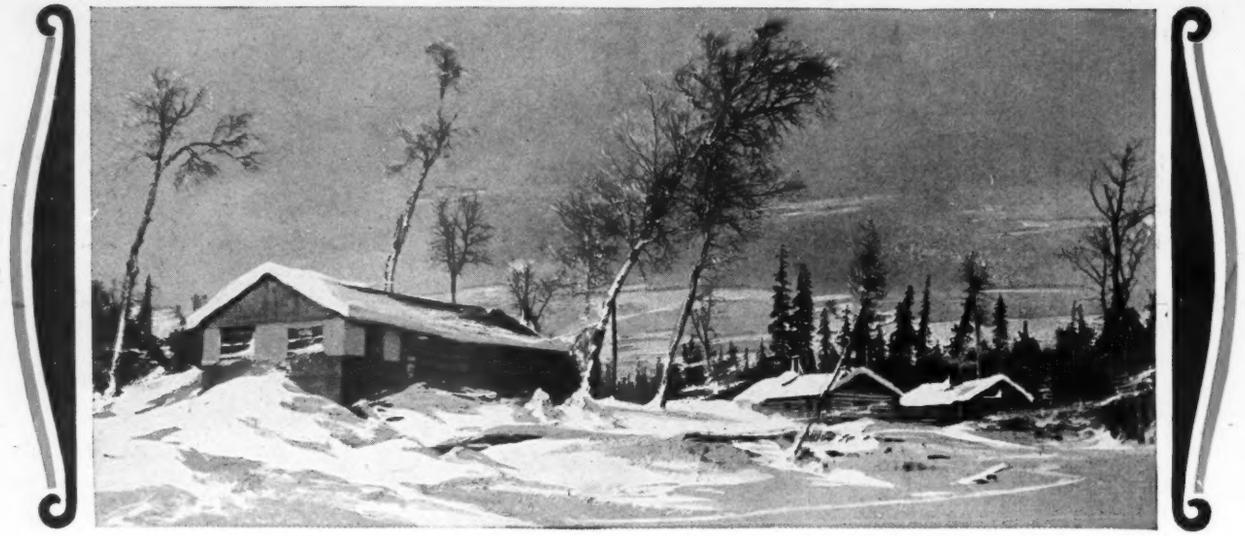
By H. W. Aldrich and W. G. Scott

United Verde's Electrical Equipment

By A. I. Greenwood

C. F. Kelley on the Modern Trend in Mining

Preliminary Impoverishment in Gold-Ore Treatment, by A. M. Hamilton . . . Automatic Caging Devices at the Horne Copper Mine . . . Installing the New Hecla Hoist



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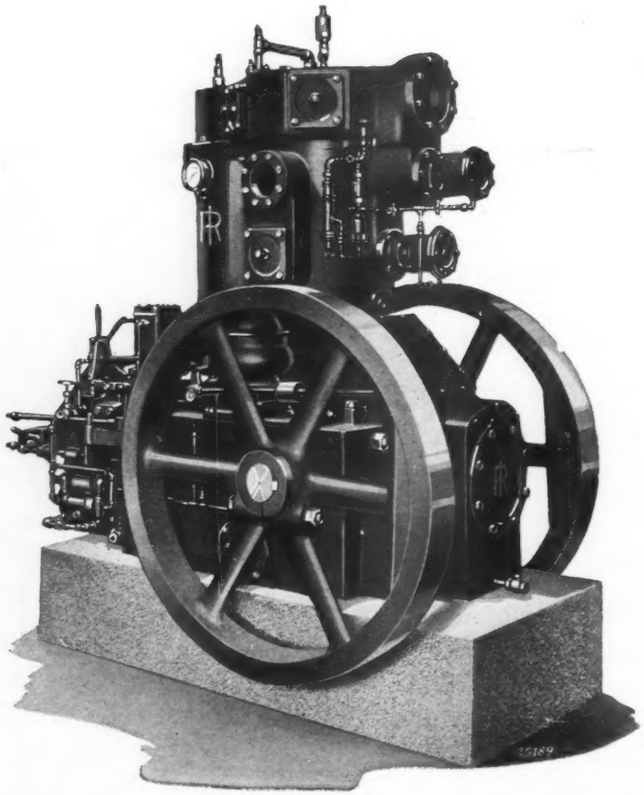

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ENGINEERING AND
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A McGRAW-HILL PUBLICATION — A. W. ALLEN, *Editor* — ESTABLISHED 1866

VOLUME 128 — New York, October 26, 1929 — NUMBER 17

Possibility of Important Mineral Discoveries in the Antarctic

THE possibility of finding mineral deposits of economic value in the Antarctic is uncertain. Nevertheless, with three exploration parties in the southern polar regions during the current season of 1929-30, notable geological and mineral discoveries, as well as important additions to geographical and meteorological knowledge, may be made.

All three expeditions will investigate particularly the fringe of the polar plateau. Under the direction of Dr. L. M. Gould, who holds a professorship in geology at the University of Michigan, a party from the Byrd expedition will journey with dog sleds beyond the Ross ice shelf to study the geology of Carmen Land, the Queen Maud Range, and that near Mount Nansen. The region south of Australia that extends from the Ross Sea in the east to Enderby Land in the west will be studied by the expedition lead by Sir Douglas Mawson, professor of geology and mineralogy at the University of Adelaide. This work will be a continuation of that begun by the Mawson expedition of 1911-14. Sir Hubert Wilkins is undertaking to chart, by aërial methods chiefly, the coast line from Hearst Land to the Ross Sea —about 2,000 miles. This endeavor is part of the exploration program started last year by Sir Hubert.

The Antarctic, unlike the Arctic, is evidently largely continental, rather than a polar sea. Much of the unexplored area is near the Antarctic Circle. Inasmuch as valuable mineral deposits have been found and developed north of the Arctic Circle, similarly situated deposits that may be found in the Antarctic might readily be exploited profitably. Coal seams have been found, and Sir Douglas Mawson, in his book "The Home of the Blizzard," which is a record of his expedition of 1911-14 to Adelie Land, states that "Apart from the moraines, the rock exposed *in situ* was mainly a uniform type of gneiss, crumpled and folded, showing all the signs of great antiquity—Pre-Cambrian, in the geological phrase. Relieving the gray sheen of the gneiss were dark bands of schist which tracked about in an irregular manner. Sporadic quartz veins here and here showed a light tint. They were specially interesting, for they carried some less common minerals, such as beryl, tourmaline, garnet, coarse mica, and ores of iron, copper, and molybdenum. The ores were present in small quantities, but gave promise of larger bodies in the vicinity and indicated the probability of mineral wealth beneath the continental ice-cap."

These words of Sir Douglas may seem optimistic, particularly as no important mineral discoveries have yet been announced from the Antarctic. Nevertheless, they indicate that something new and of interest to the mining fraternity may come out of the South Polar regions.

Metal Price Situation Outside the United States

RECENT European developments in the marketing branch of the metal industry have been none too pleasing. In general, they emphasize the fact that the prosperity of Europe is of very real importance to the metal-mining industry, and that such subjects as debts, tariffs, and stable governments are of more real importance than many realize as they hurriedly glance at the newspaper headlines.

European consumption of copper so far this year has been disappointing. The total taken by the four leading copper-importing countries—in order, Germany, France, Great Britain, and Italy—increased markedly in both 1927 and 1928, but so far in 1929 has averaged slightly below the 1928 standard. Germany and Italy have reduced their takings this year by about ten per cent. Were it not for the fact that United States consumption this year showed another big expansion, and for the further fact that production has been curtailed in the last half of the year, the market price would certainly have been well below its present level. As it is, United States producers are hoping that domestic consumption will not be affected seriously by any real or fancied industrial depression; that European demand will again show its former rate of growth; and that African production of copper will not expand too rapidly. All of these hopes may very well be realized, so that producers should not be too pessimistic about the future price. Fortunately, the price is stable throughout the world.

More alarm is justified as to what is going to happen to zinc. The London price has dropped considerably since the first of the year, which, coupled with the slight increase in the American price, has brought the markets to the points where European zinc, with a duty of 1¾c. per pound, can be sold on the eastern United States seaboard on a parity with the domestic product. If further recessions occur abroad, therefore, the present market quotations in the United States cannot long be maintained. The trouble seems to be that the chief zinc-importing countries—Great Britain, Germany, Japan, and France—are showing no increase in their requirements; in fact, they are taking less this year than last, and they took less last year than the year before. On the other hand, world production has increased every year since 1921, and promises to be perhaps 50,000 tons more this year than last. Either consumption abroad must increase or production must be cut if current prices are to be maintained.

Silver and tin producers are enjoying, speaking very euphemistically, the lowest prices in the London market since 1915 and 1923, respectively. Silver has shown no particular tendency to touch bottom at 23 pence, and the alarms about the possibility of tin getting as low as

£200, expressed a little over a year ago, do not now appear to have been so radical, with tin selling, as it is, around £190. In both of these metals, some curtailment of production would seem to be in order if the market is to be supported.

Lead alone seems to be behaving very satisfactorily, viewed from almost any angle. European prices have been well maintained throughout the year, as have American prices, and the principal importing countries—Great Britain, Germany, France, and Japan—seem likely to register a satisfactory increase in the current year over last year's consumption.

The metal industry as a whole must give thought to two factors. One is furtherance of consumption, and this applies particularly to European countries. Every support should be given to constructive measures that will cause the spread of American prosperity to other nations, which will, in turn, increase their per-capita metal consumption. The other important factor is an intelligent regulation of production to the trend of consumption. In this respect the copper producers have made great strides, but producers of other metals remain largely individualists.

Manganese Industry's Problems Incite Metallurgical Ingenuity

SPEAKING in behalf of the manganese ore producers at their recent convention in Washington, Mr. W. B. Daly, Anaconda's general manager of mines, discussed the new processes being applied for treating manganese ores. Among these was the leaching process, developed by Mr. Wilson Bradley, of Minneapolis. Those familiar with the details will recall that the leaching reaction, which changes the oxide to a sulphate of manganese with evolution of ammonia gas, is reversible. This fact has caused some to doubt if the process could be controlled so as to work only in the desired direction and not back-fire, so to speak. Mr. Bradley, who was present at the convention, explained that the controlling factor in keeping the equation going in the direction desired is the depth of liquor in the digester. Where this is fifteen to eighteen feet, hydrostatic pressure is built up, which tends to retard the release of the ammonia gas and to force it back into solution before it can reach the top and make the equation work backward. With shallow depth the pressure is insufficient to produce this effect. The difficulty is further relieved by the fact that ammonia gas is less soluble in the liquor at 200 deg. F. than at 100 deg. F., so that, by using the former temperature to expedite the release of the gas, no opportunity is given for the reaction to reverse.

At this stage the manganous sulphate is in solution. After the solution has been clarified and the released ammonia gas recaptured, gas and liquor are brought into contact in an ammonia tower and the manganese is precipitated as unstable manganous hydroxide. This defect of instability is cured by immediately treating the hydroxide with oxygen (added to the gas as atmospheric air), thereby converting it to partly dehydrated manganic hydroxide, which is stable. In this manner, the direction of the equation here is also definitely controlled. Thus Mr. Bradley purged his process of the hazard of reversibility.

Another process discussed at the meeting, involving the use of acetylene tetrabromide, a heavy liquid, to separate ore minerals from their gangues, was described in *Engineering and Mining Journal* of October 12. Iron and manganese ores are being treated experimentally at Wilmington thus; and ores, concentrates, and smelter residues of copper, lead, and zinc at Houghton. The process, described as simple, effective, and cheap by Prof. A. T. Sweet, of Houghton, will recall to many metallurgists the former attempts made to utilize Sonstadt's solution—of potassium-mercury iodide—for the commercial separation of minerals. A high cost was the main obstacle to further research. Other varieties of heavy solutions have possessed the same disadvantage, coupled with difficulty in recovering from concentrate and gangue the separating liquid, the loss of which is effected by two causes: mechanical and physico-chemical. Of the two, the latter is more subtle, adsorption playing its part in complicating the problem. Thus, by using a Sonstadt solution, a separation of coarse from fine particles of the same mineral may occur, the finer sinking and the coarser floating, the segregation being produced by the greater surface exposure of the former and more intense tension effects, which lead to an adsorption, on the particles, of a substance in the solution. This adsorbed substance is removable with difficulty, if at all.

The hazard of adsorption in the use of a heavy liquid as a means of separating materials of different specific gravities may account for the statement that acetylene tetrabromide works best on particles above ten mesh. However, it possesses an obvious advantage over Sonstadt's solution in that it is immiscible with water. We are assured that its use is practicable from the cost standpoint, and further data and operating results will be awaited with interest.

This most recent development in the treatment of manganese ores, the result of research in the chemical industry, offers evidence of a determination to expand the consumption of a domestic product, bromine, by developing new uses, the cost of production being lowered to a large extent in proportion to the increased demand developed by research of this character. If the Chilean iodine industry would adopt the same attitude it would soon discover many opportunities for a larger market and a more broadly distributed prosperity.

Light's Golden Jubilee Reaches Its Climax

LIGHT'S GOLDEN JUBILEE, which reached its climax recently at Dearborn, Mich., when most of the world listened in by radio to the speeches of President Hoover, Mr. Edison, and Mr. Owen D. Young, must have been inspiring to many peoples of the earth, besides awakening in them a more appreciative realization of the benefits that have accrued to mankind within the last few decades. The jubilee, although serving appropriately enough as a milestone in the recording of scientific achievement, has been more particularly a fitting tribute to Thomas A. Edison.

Endowed with rare ability and the intense desire for applying his self-acquired knowledge, Mr. Edison has wrought accomplishments that have brought to him the

profound respect of the world's most highly trained technicians. His mind is pre-eminently inquisitive, and his field of endeavor widespread. Few, for instance, are aware that Mr. Edison has contributed directly to geological knowledge and, besides, directed for ten years, at the close of the last century, a painstaking and thorough attempt to mine and concentrate on a commercial basis certain iron ores found in the mountainous section of northern New Jersey. The most systematic magnetic surveying that has ever been done in the state was that undertaken under his direction twenty-five years ago. Results of the work, particularly of that performed in the vicinity of Edison, New Jersey, revealed large reserves of magnetite that were previously unknown.

In addition to the common debt owed to Thomas A. Edison by all mankind, the members of the mining industry are justified in feeling that the store of scientific knowledge in their profession has been enriched by contributions from the world's outstanding inventor, scientist, and benefactor.

Railroads Need Vast Quantities of Non-ferrous Metals

ANNOUNCEMENT was recently made that the New York Central Railroad had placed an order for thirty-five locomotives of a new type—each with a combination Diesel-engine, electric-generator, storage-battery power unit. The motors on the locomotives may be operated direct from the storage battery, or from storage battery and Diesel engine, or from a third-rail collector. Statistics in reference to these new units are impressive. The cost to the company for this addition to its locomotive fleet will amount to over four million dollars, but what is of major interest to the field of *Engineering and Mining Journal* is the tremendous weight of the Exide storage batteries to be used—over seventeen tons for each locomotive! The lead industry should be greatly interested in an expansion of this character. In the manufacture of the generators, motors, and panels of the electrical equipment to be used, large quantities of copper and other non-ferrous metals will be absorbed.

Imperial Chemical Industries—a powerful organization in Great Britain with a capitalization of about £95,000,000, and operating in the chemical and non-ferrous metal industries—recently had an interesting exhibit at an industrial fair in England, which demonstrated how large a quantity of copper may be used—and, for the sake of economy and efficiency, should be used—in the construction of a modern steam locomotive. The total may aggregate as much as ten tons of the red metal per unit, distributed in the firebox and boiler tubes, the door, tube, and wrapper plates. As explained in the current issue of *The Overseas Engineer,* these plates are made of refined copper, a small quantity of arsenic being afterward added to increase strength and hardness—to resist the abrasive and erosive action of clinker and furnace gases. The original alloy ingot is rolled hot, and then fashioned to shape in the cold. Finally, the plate is annealed to free it from adherent oxide. The firebox stays in a locomotive are also being made of copper.

Locomotive traction seems likely always to remain the most important means of transportation. Whatever the method of generation of power—by coal or oil to form steam, or by the combustion of oil vapor to supply power for electric generators, and to store such power in batteries—the non-ferrous metals will always find extensive application at an increased scale in this, a basic industry of every large progressive country in the world.

Injustice as an Incentive to Success

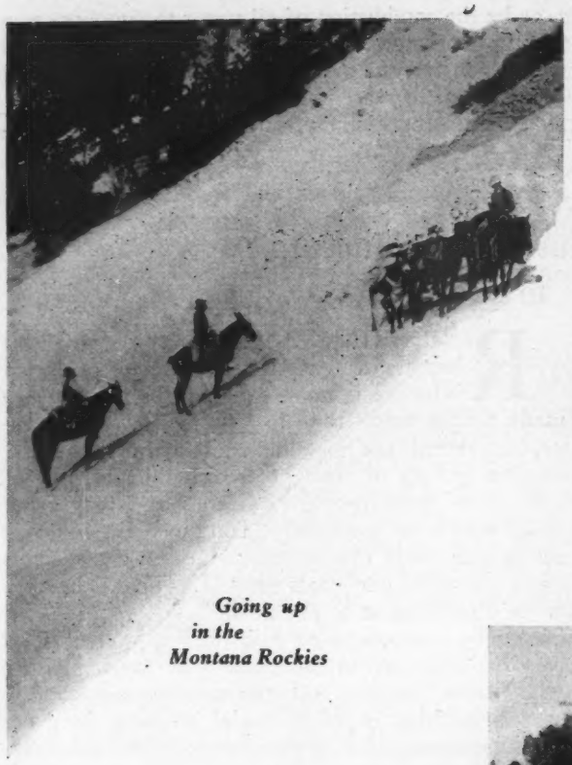
RUDYARD KIPLING recently warned his hearers, a gathering of schoolboys, that injustice is more common than the justice that many people waste time in looking for. Most injustices, he averred, are not inflicted deliberately, but are the outcome of lack of thought; which thought, if persisted in, gives some people headaches and may cause them to change their opinions. "Too much fussing over abstract justice leads one to stand up for one's rights and dwell on what one owes oneself. That," he concludes, "is a temptation of the devil."

No one who contacts much with his fellow men in all walks of life can fail to recognize that rank injustice appears to be a frequent and inevitable concomitant to human relationships in every social stratum, in every profession or industry, in every country. This is a statement of fact, not an exhibition of pessimism. The trouble is that the victim usually broods over his misfortune, instead of using the opportunity as a stepping stone to a new field of activity. The greatest thrill in life comes when the object of an injustice who ultimately reaches success in constructive work can congratulate himself on his restraint toward those who sought his downfall, but who succeeded only in cramping their own moral and material progress.

For the unscrupulous, the greatest field that offers for the infliction of hurt is in the theft of ideas. And the man with an inventive mind, by his very nature, is the easiest game. Tragedies of this kind are being enacted daily, in many forms and under widely varied conditions. Inevitable is the outcome if injustice possesses the necessary influence and power, which it usually does. As a result, the inventor becomes discouraged, nurses his grouch, and quits the race.

But, even as the murderer returns to the scene of his crime, so is the inventor drawn irresistibly back to inventive effort, despite the hard knocks he may receive, just and unjust. However much he may forswear interest in what is unknown and untried, and even though he promise himself relaxation to the humdrum existence of a man with an allotted task, his resolutions will break like pie-crust. He must get rid of the grouch, however, and to do this effectively he should seek diversification of interest. Credit or reward may have been filched from him, but no one can steal the sharpness of mentality induced by systematized inventive effort.

Plenty of problems are awaiting solution. If the technician has trained himself to think and to reason, the most important items of equipment for research work are at hand. But inventiveness is a form of initiative that seems to be born only to be squelched out of existence by persistent discouragement, the only remedy for which is the union of science with commercial acumen and the early attainment of financial independence. A combination of poverty and inventiveness invites injustice.



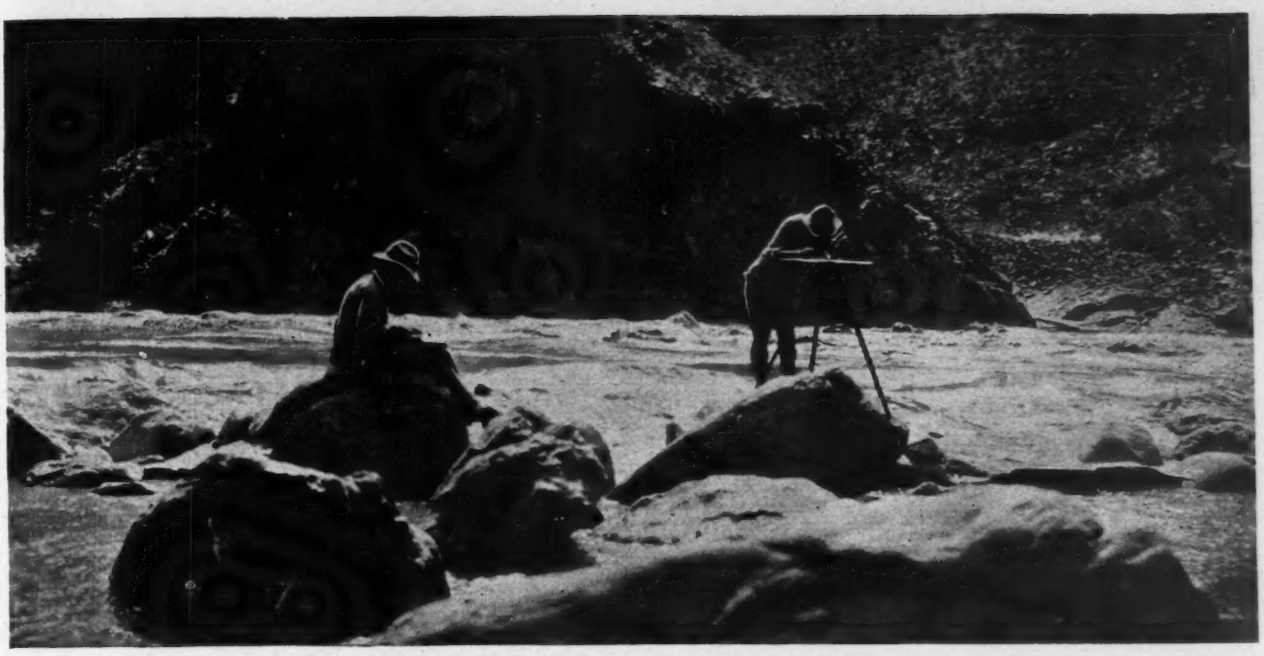
Reconnaissance and Map-Making Work

By the U. S. Geological Survey

Going up in the Montana Rockies

Surveying along the American River, in California

Packing up portage on a Grand Canyon survey trip



Topographers at work at Crystal Creek, Colorado

Above—Resting en route in Alaskan snows

By way of contrast—in sunny California

Slime Treatment and Electrolytic Precipitation at Inspiration

HAROLD W. ALDRICH
and
WALTER G. SCOTT

Superintendent and Assistant Superintendent, respectively, Inspiration Leaching Plant

ALTHOUGH the results of leaching at the Inspiration plant in 1927 and 1928 equaled estimated figures, many anxious moments were spent and volumes of data accumulated to determine definitely what caused the wide variation in the percentage of copper lost in the tailing on various charges. That fine material in a leaching charge, particularly if colloidal, will interfere seriously with percolation, and consequently affect extractions, has long been recognized. Ore was being mined from three separate locations in which the ore was different in physical character as well as in copper content. In most instances poor extractions accompanied, and were somewhat commensurate with, a larger amount of a particular type of ore. In the early months of operation, selective mining could avoid those areas which produced a maximum of primary fines, but, later, even those areas conceded to have good leaching ore gave trouble at times.

In the fall of 1928, the officers of the leaching department decided that the department should equip itself so as to be able to accept and make a satisfactory extraction from any ore that the mining department should care to mine. As the question of separate treatment of fine and coarse material came up early in the test- and pilot-plant work, a large amount of experimental data was on hand pertaining to this problem. Experiments showed that the minus-200-mesh made in crushing was granular, whereas the minus-200-mesh coming from the ore before crushing was amorphous. Furthermore, colloidal fines hindered percolation far more than granular fines.

The plant flow sheet accompanying the article in the Oct. 19 issue shows that all ore passes over the primary screens before entering the fine-crushing plant. Those responsible for operations recognized the fact that if the minus-200-mesh material could be separated from the undersize of the primary screen product, not only would the minus-200-mesh in any charge be reduced, but this separation would carry the undesirable colloidal material. Screen analysis of the tailing showed that if the ore could be crushed finer without hindering percolation, better extractions could be had. The size of crushing had, therefore, been a compromise with the copper in the tailing.

Two ways of separating the colloidal fines from the ore were suggested: One was air separation, and the other hydraulic separation, but the moisture in the ore was too high for successful air separation.

Dorr classifiers, borrowed from the concentrating department, were installed to handle the undersize from ¼-in. screens. The feed to this unit was estimated to be 3,000 tons per day, which was a third of the plant total. This material carried 25 per cent minus-200-mesh and an estimation indicated that an 80 per cent separation could be made. This would result in the removal of 600 tons of fines, which would require a separate treatment plant.

The proposed equipment was to serve as a large-scale test on ten 9,000-ton lots.

The first tank to be charged, with the fines removed, was excavated on Dec. 31, 1928, and the second tank on Jan. 3, 1929. As percolation difficulties were being encountered at this time, with the usual corresponding high tailing, the contrast shown in the following table is necessarily striking.

Comparison of Results With and Without Fines Removal

Lot No.		Cu in Tailing			Extraction of Cu		
		Ox.	Sul.	Total	Ox.	Sul.	Total
750	Normal.....	0.10	0.24	0.34	86.5	41.5	70.4
751	Fines out.....	0.03	0.08	0.11	95.4	81.4	89.4
752	Normal.....	0.14	0.29	0.43	80.8	25.6	61.6
753	Normal.....	0.15	0.28	0.43	80.5	28.2	62.9
754	Fines out.....	0.02	0.07	0.09	97.1	80.0	91.3
755	Normal.....	0.10	0.19	0.29	86.3	38.7	72.1

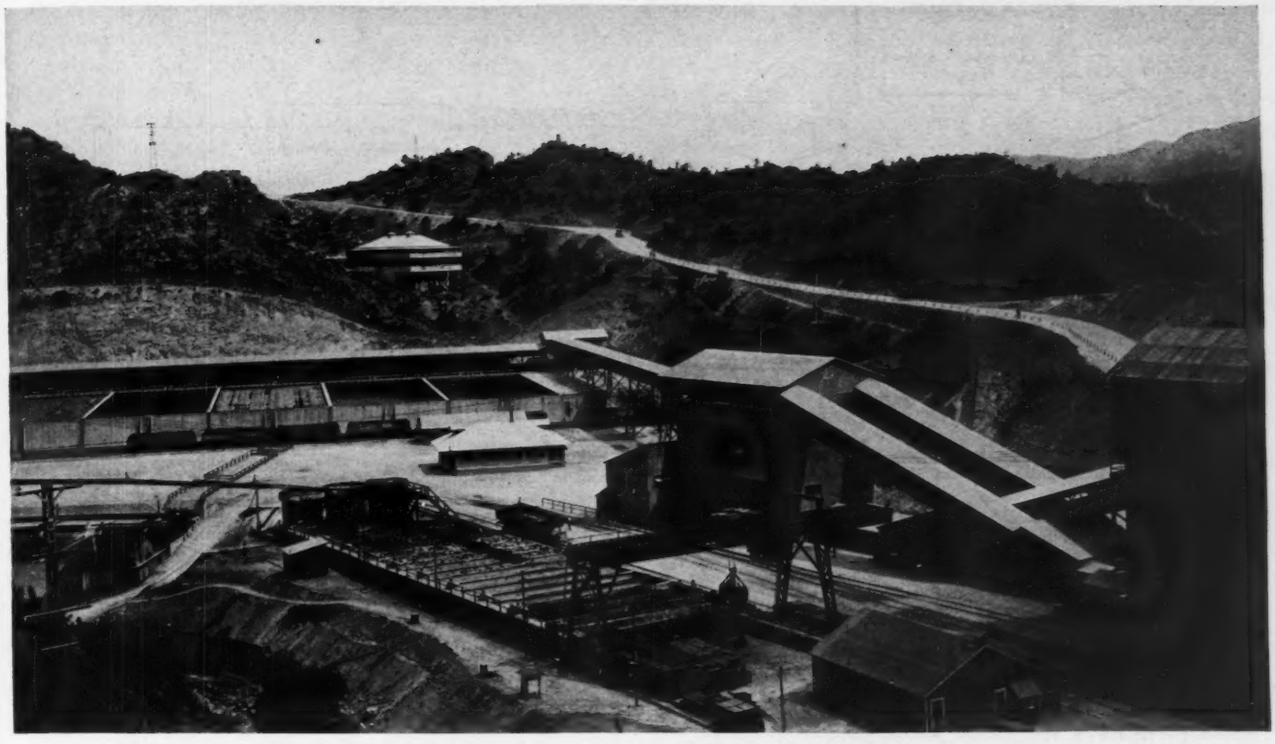
Everything indicated that the removal of the primary fines was the correct procedure, and with only two test tanks completed the practice was standardized on the removal of fines from all charges.

Metallurgical results for the first six months of 1929, compared with those of 1927 and 1928, are interesting, and are shown in an accompanying tabulation.

Although an estimate showed that 600 tons of classifier overflow would be treated, this tonnage probably will be closer to 500 tons of fines, carrying 90 per cent minus 200 mesh. At present these fines, which run higher in copper content than the regular feed, are being stored for future treatment.

A flow sheet of the proposed plant is shown in an accompanying sketch. The bowl classifier overflow is now piped to the concentrator, where flotation removes the available sulphides. Flotation tailing is to be run to a thickener. The clear water overflow will return to the concentrator proper and the underflow will be pumped to

The first part of this paper, describing the leaching of the ore, was published in the Oct. 19 issue.



Iron launders in foreground, leaching plant at rear, and crushing plant at right

storage tanks which precede agitation in the leaching division. Experiments show that flotation results are better when flotation precedes the acid agitation leach rather than when it follows. This also avoids flotation of an acid pulp and the possible contamination of the present concentrator alkaline circuit.

Flotation Results for June, 1929

	Per Cent Oxide	Per Cent Sulphide	Per Cent Total Copper
Feed	1.205	0.316	1.521
Tailing	1.113	0.076	1.189
Extraction	7.635	75.949	21.828

The agitation leach is to be conducted in series so as better to control the acid in the copper solution for iron precipitation. This also gives a continuous flow for counter-current washing. Experiments show that when leaching the present flotation tailing with sulphuric acid, a total tailing better than 0.20 per cent copper can be expected. The slime material to be leached will consume more acid than the present percolation leach, though in reality the total acid consumption for the agitation leach plus the percolation leach should be the same. According to estimates, an equivalent of 25 lb. of 100 per cent acid will be consumed on impurities in the agitation leach. By using four thickeners and passing the tailing solution from the iron precipitation in counter-current flow with the leached pulp, theoretical figures backed by laboratory experiments show that 97 per cent of the dissolved copper will be recovered.

The proposed plant will be in operation, the management believes, by January, 1930.

Electrolysis in the Pilot Plant

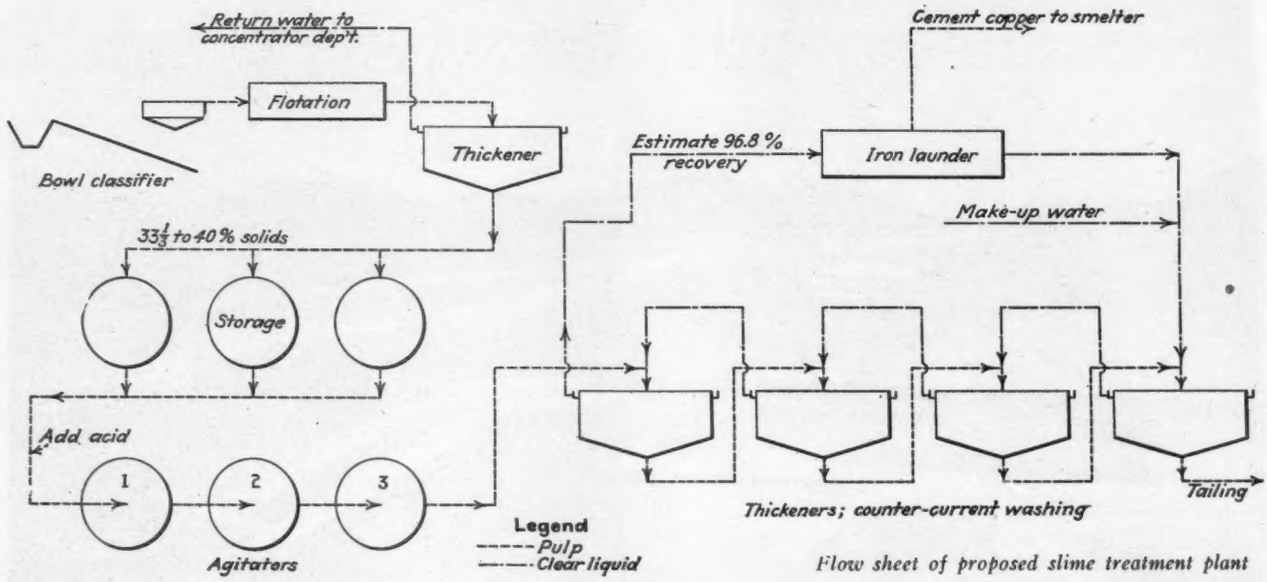
The precipitation division of the pilot plant consisted of fourteen tanks with sixteen 42x36-in. cathodes per tank. Sufficient generator capacity was installed to permit wide variations in current flow. The plant was arranged so that the solution flow could be either in parallel or in cascade and solution heating could either precede or follow electrolysis. Both in the construction and operation of this unit, an attempt was made to provide conditions equivalent to those of large-scale operation. A great number of variables, both mechanical and metallurgical, were tested during the operation of this plant. A few of these are mentioned:

Many of the common methods of hanging cathodes were tried. The refinery type of loop, most commonly used, would last only a few days before cutting off.

Comparative Results in Leaching

	1927	1928	First 14 Charges Jan., 1929, Unclassified	Last 17 Charges Jan., 1929, Classified	1929 Feb.	1929 March	1929 April	1929 May	1929 June
Feed Assay, per cent:									
Oxide copper	0.711	0.637	0.726	0.759	0.692	0.674	0.650	0.657	0.659
Sulphide copper	0.343	0.385	0.373	0.407	0.402	0.533	0.521	0.513	0.526
Total copper	1.054	1.022	1.099	1.166	1.094	1.207	1.171	1.170	1.185
Tailing Assay, per cent:									
Oxide copper	0.048	0.053	0.107	0.019	0.015	0.022	0.021	0.020	0.020
Water-soluble copper	0.011	0.012	.....	.....	0.002	Trace	Trace	Trace	.....
Sulphide copper	0.129	0.135	0.240	0.090	0.096	0.106	0.103	0.086	0.085
Total copper	0.188	0.200	0.347	0.109	0.113	0.128	0.124	0.106	0.105
Extractions, per cent:									
Oxide copper	91.78	89.71	85.26	97.50	97.54	96.74	96.77	96.96	96.96
Sulphide	61.83	65.12	36.66	77.89	76.12	80.11	80.23	83.24	83.84*
Total	82.20	80.37	68.43	90.65	89.67	89.40	89.41	90.94	91.14

NOTE:—The percentage of copper in the tailing shown above is the percentage of copper in the tailing from the percolation leach and does not include the copper contained in the slime discard, which was stored for future leaching treatment.



Flow sheet of proposed slime treatment plant

The split loops such as those used at Ajo did no better. Any joint below the solution line apparently would not be satisfactory, so it was then proposed to bend the entire sheet over the supporting bar. This helped matters, but instead of the loop eating off at the punch in two or three days, the entire sheet would cut off at the solution line in three to five days. By painting the sheet at the solution line with almost any kind of semi-acid-resisting paint, this cutting off was entirely remedied. Loops were next attached above the solution line and the sheet was painted at the solution line. This type of sheet was decided upon because of its smaller size, as it required a finished sheet 42x44-in., compared to one 42x57-in. when the entire sheet was bent over the supporting bar.

Many experiments were made with anodes using various diaphragms; graphite anodes, rod anodes, lead-antimony anodes, and lead anodes. The lead anode containing 4 per cent antimony seemed to be entirely satisfactory in this work and was decided upon. Knowing that this type of anode would warp, and that straightening would be necessary, a thickness of ¼ in. seemed to be the lightest practical weight for operation and at the same time offered economy in construction.

The spacing of electrodes was originally 4½ in. Some of the operatives thought that a closer spacing would bring about a power saving, so a great deal of study was given this point. Spacings as close as 3½ in. were attempted, but the 4½-in. spacing was eventually accepted. This has since proved to be a wise move owing to the excessive sprouting which has been encountered.

The various types of contacts proposed caused considerable controversy, and every type of contact suggested was given a trial. Particular attention was given to forced or pressure contacts, which proved to be good theoretically, but they were discarded because of their practical inconvenience and the insufficient saving effected. Experience indicated that contact losses should never exceed 1.0 per cent if given a fair amount of attention. Although various types of flat and V-notched contacts were tried, the notched supporting bars were finally decided upon. When using a busbar common to two tanks, the notched supporting bar is valuable in maintaining the proper spacing and thus avoiding busbar short circuits; it also maintains a better contact.

Electrolyte extremes were also attempted, with ferric sulphate exceeding 15 grains per liter, as well as with acid and copper variations beyond the practical limits required for leaching.

The Plant as Finally Built

General Electrical Data—The generating equipment has a capacity of 36,000 amperes at 320 volts. It consists of three units, each having two generators, centrally driven by a 5,450-hp. 500-r.p.m. synchronous motor. Each generator has a capacity of 6,000 amperes at 320 volts, giving each unit a capacity of 12,000 amperes at 320 volts. All generators supply a single circuit which passes around the tank house in the shape of a U.

As the tanks are arranged in two parallel lines, extreme precautions are taken to avoid tank short circuits. An 11-ft. length of 4-in. hose is inserted in the solution feed line to each tank, and a 16-ft. length of 12-in. rubber hose in the pump suction protects the circulating pump. The tank overflow drops approximately 9 ft. through a 6-in. tile pipe to a central distributing launder.

The tank house consists of 120 commercial tanks and sixteen starting-sheet tanks of practically the same size.

Starting-Sheet Division—As the tank-house metallurgy must be regulated to suit leaching conditions, there are times the circulating solution is not entirely suited for the making of a good starting sheet. A small refinery, self-contained, is therefore set aside for this work. In this division are sixteen tanks of the regulation size, each tank having a capacity of 84 blanks (cathodes) and 85 anodes, making a total of 1,344 blanks, capable of making 2,688 starting sheets per day. The loops must be cut from this production, so 15 per cent is usually allowed for loops, blanks not stripped, and scrap. This gives a capacity of 2,285 finished starting sheets per day. Production is, however, regulated to meet the requirements of the commercial department, which, in turn, is dependent upon the desired production of copper. The blanks are of refinery type, of rolled copper, with a groove on each side and on the bottom, to produce a clean-cut sheet. Side edges are baled and shipped as scrap.

The finished starting sheet is 44 in. long by 42 in. wide. The loops, which are cut with power shears, are

20 in. long by 4 in. wide before looping. Two inches on the end of the starting sheet are allowed for punching. This gives a finished sheet which allows 42 in. square for submergence, with the entire loop and punching above the solution level.

A new rolled-copper blank is cleaned, amalgamated, polished, and properly oiled, after which it is ready for operation. Blanks are removed for stripping in groups of fourteen, and the lifting basket is spaced so as to lift alternate blanks, which permits more working room. At first, a steel tool made of small-size hexagonal steel, properly sharpened and curved, was used for starting and stripping the starting sheets from the blanks. After eighteen months of operation a wooden tool made from an ordinary pick handle, with a steel end suitably attached to be used as a starter, has been substituted, and this does not scratch the blank. A perfectly smooth and polished blank allows easier stripping and yields less starting-sheet scrap.

After stripping, the blank is touched with amalgam solution wherever the steel starting tool has scratched it. A cheap grade of oil is applied with Duro cloth swabs, and the blank is then returned to the refining tanks.

Blister-copper anodes, cast from converter copper, are received from the International smelter. These range in weight from 900 to 1,100 lb. each. The set side of these castings is usually quite rough and has occasional slag spots, but this type of anode has been handled with comparatively little trouble, although new anodes do not consistently produce a good sheet for the first few days. The plant is not equipped to work up odd lots of varying sized scrap anodes, so when a tank shows some scrap, the entire tank is scrapped. To date, 22.8 per cent of anode scrap has been made, a rather high figure, which may be accounted for by the wide range in original anode weights.

Electrodes are spaced 4½ in. from center of cathode to center of cathode and blanks are stripped every 24 hours. A current density ranging from 14 to 16 amperes per square foot is used and the average starting sheets weigh from 11 to 12 lb. each before looping. The solution circulation rate is 15 gal. per tank per minute and the solution carries from 30 to 40 grains per liter of copper and 120 to 150 grains per liter of acid. Accumulation of impurities is prevented by bleeding refinery electrolyte to the commercial division. Two hot wells maintain a temperature of approximately 55 deg. C. From 8 to 15 lb. of glue are added per day at the discretion of the operator.

Refinery mud, carrying gold, silver, and copper, is washed to settling tanks, dried in open pans, and shipped.

Commercial Division — The commercial division consists of 120 electrolytic tanks, 33 ft. long, 4 ft. 3 in. deep, and 4 ft. wide. These are divided into eight banks of fifteen tanks each, the electrolyte flowing in series through the eight banks. Each bank has a solution circulation of approximately 1,500 g.p.m., or 100 gal. per tank per minute.

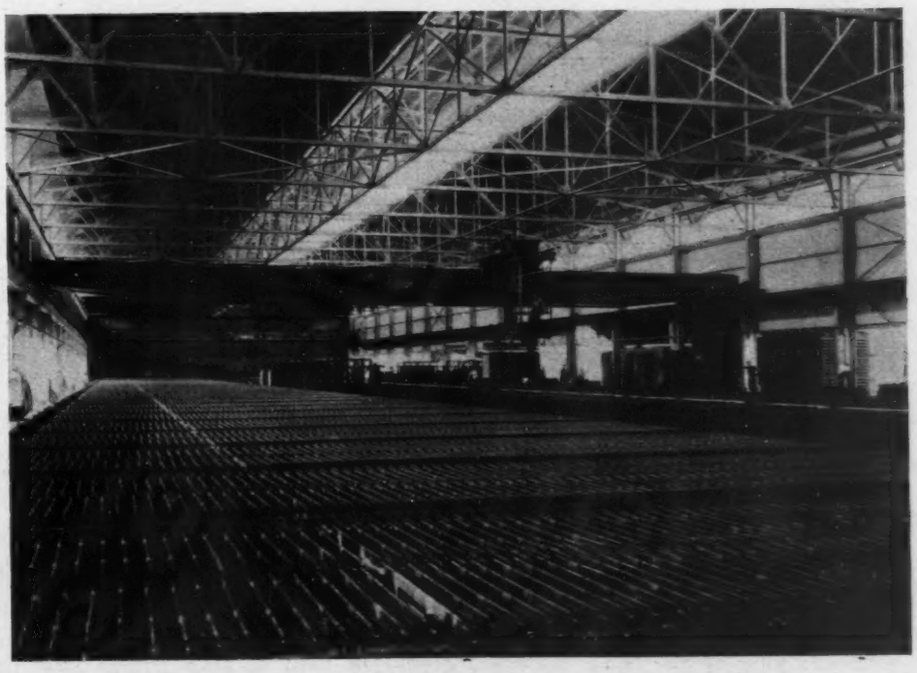
Each tank has 84 cathodes and 85 anodes, spaced 4½ in. from center of cathode to center of cathode and placed perpendicular to the direction of solution flow. This makes a total of 10,080 commercial cathodes and 10,200 lead anodes. The original anodes were made of ¼-in. 4 per cent antimony lead, 38x40 in. submerged, and supported by copper bars. Each anode was punched for eight porcelain insulators, which tend to prevent short-circuiting, but later only five of these were used.

At the start of operation, the men in charge thought that an occasional straightening of the lead anodes would suffice. This was quickly disproved, and an improvised press, handling one anode at a time, was made, and the pressure for straightening was applied with hammers. It was possible to straighten each anode in the tank house every thirty days. After a few months of this kind of straightening, the lead began to flow and the submerged area increased, which caused the cathode edges to sprout badly. Trimming the anodes was a large task. The ¼-in. antimony-lead anode was apparently too light and the tank-house results obtained during the months following this poor anode condition seemed to prove the need of an anode press. A press of a capacity to straighten each anode in the entire tank house every fifteen days was needed. A locally designed press, operated by air pressure, handling fourteen anodes at one time, accomplished this work.

In October, 1928, the company decided to replace all anodes, making them heavier and stronger. Experiments were started in 1927 to determine the best type of anode to be used. After being in service for one year, the 8 per cent antimony lead anodes, ½ in. thick, were in excellent condition and were perfectly straight. The lead anodes containing 13 per cent antimony plus arsenic, ½ in. thick, were also in excellent condition but were too brittle to handle.

At present the entire tank house is equipped with ½-in. lead anodes containing 8 per cent antimony. These were cast and fabricated at this plant.

Electrolytic department



Tank-House Results

Month	Current Density	Kw.-Hr. A.C. per Lb. of Cu	Cathode Efficiency	Anode Efficiency	Copper, Grams per Liter In	Copper, Grams per Liter Out	Acid, Grams per Liter In	Acid, Grams per Liter Out	Ferric Iron, Grams per Liter In	Ferric Iron, Grams per Liter Out	Total Iron, Grams per Liter
1927											
January	10.0	1.415	61.65	40.3	23.3	17.1	56.4	77.0	5.6	10.0	15.0
February	12.7	1.472	62.43	44.0	26.3	19.2	42.9	63.0	4.4	9.9	16.6
March	15.0	1.658	56.47	45.6	26.4	19.3	43.4	61.2	4.6	10.3	19.2
April	14.7	1.677	57.56	47.1	28.0	22.2	41.5	57.8	7.3	12.1	20.7
May	14.8	1.628	59.48	42.1	27.8	21.3	37.4	55.3	6.8	11.6	18.8
June	15.9	1.679	60.69	43.2	29.8	24.4	42.6	57.7	7.7	11.8	19.6
July	15.0	1.637	60.42	38.9	29.5	24.5	42.8	56.7	7.8	11.1	18.2
August	15.7	1.713	59.00	38.1	28.0	22.3	42.4	55.5	6.1	9.9	16.4
September	14.2	1.550	63.00	45.0	28.5	23.0	36.9	49.7	4.6	9.0	15.9
October	14.5	1.653	64.92	42.5	32.0	26.8	37.3	49.8	6.0	9.8	16.9
November	14.4	1.571	66.01	40.3	30.2	25.3	37.8	48.2	5.4	8.6	14.7
December	12.6	1.500	70.19	43.5	28.0	22.5	35.1	47.3	4.3	8.6	15.1
Average	14.1	1.596	61.82	42.5	28.2	22.3	41.4	56.6	5.9	10.2	17.3
1928											
January	11.7	1.463	69.12	54.7	25.3	20.2	31.6	45.9	5.3	9.7	17.7
February	12.7	1.582	65.12	48.5	24.4	19.2	30.3	45.8	5.3	9.7	16.6
March	11.3	1.466	67.91	42.7	25.0	19.8	28.5	44.9	5.8	9.7	15.4
April	11.7	1.504	66.91	42.3	23.1	17.7	32.5	45.5	5.6	9.5	16.4
May	10.8	1.393	66.00	41.4	21.6	16.6	30.8	45.4	5.7	9.4	15.7
June	11.0	1.438	65.82	47.3	19.8	13.9	30.3	45.6	5.3	9.4	15.4
July	10.0	1.547	63.37	53.2	20.1	16.0	29.3	43.0	5.2	8.9	14.4
August	11.6	1.566	63.46	41.6	23.8	18.5	29.1	45.0	5.0	8.7	13.1
September	12.9	1.580	63.53	39.8	25.3	19.5	30.3	44.1	4.6	8.6	13.4
October	11.7	1.516	63.87	37.8	22.7	17.4	32.5	43.5	4.7	8.3	12.2
November	12.5	1.608	61.95	48.1	24.5	19.6	32.0	46.0	5.3	9.4	15.1
December	14.1	1.799	58.80	49.4	24.4	19.4	29.5	45.2	5.3	9.5	15.7
Average	11.8	1.538	64.66	45.6	23.3	18.2	30.6	45.0	5.3	9.2	15.1

Starting sheets are threaded (insertion of copper supporting bar), painted, and straightened, by contract labor. Painting is done just at the solution line with a single stroke of a brush, using a cheap semi-acid-resisting paint. A sheet not painted in this manner will cut off at the solution line in about five days. The sheets are then grouped on racks, moved by the crane opposite the tank where they are to be used, and are placed in the tank by hand.

Each cathode is straightened at the end of 24 hours. During the first months of operation a 48-hour sheet was also straightened, but this practice has been discontinued. At present the sprouts are knocked from a 3½-day sheet. After each movement, the cathodes are checked by meter men for poor contacts or short circuits. Both a voltmeter and a locally designed millivoltmeter are used to detect short circuits and faulty contacts. The latter consists of two contact points, accurately spaced in a small wood frame which is placed on the cathode supporting bar, and the current flow is recorded in millivolts. This is a very sensitive means of detecting trouble.

Best results are obtained by pulling a finished cathode weighing between 90 and 100 lb., total weight. The cathode life, therefore, varies with the current flow. A five-day cathode is pulled for a maximum production. In pulling copper, 21 cathodes or one-fourth of a tankful are lifted at one time, conveyed to the wash tank, and submerged in boiling water. From here they are dropped on to a steel rack with an inclined back, by moving the crane slowly backward and permitting the cathodes to knock themselves off the crane basket. Two pulls, or 42 cathodes, are placed on each rack. A storage-battery truck with a low platform slides under the loaded rack and raises and transports the load, first over the scales and then into railroad box cars for shipment. In the cars the cathodes are lifted by hand and stacked as desired. This fast and economical method of handling produced copper permits a variation in the life or weight of finished cathodes which is extremely important.

The weight of copper from each electrolytic tank is recorded, and the efficiency figures for each day's production are arrived at by using ampere and voltage readings taken each shift during the life of the particular cathodes pulled. Starting sheets going to each tank are weighed, this weight being deducted from the total cathode weight to obtain the weight of copper precipitated. Tank voltage readings are taken each shift and carefully compared to the total switchboard voltage. In the generator room hourly ampere readings are recorded, and the kilowatt input and output of the generator station is measured by recording meters. All final figures from this department are based on copper production and power actually paid for. The latter figure includes line loss from substation to generators, and generator conversion efficiency, as well as all transmission, contact, and minor losses.

Tank-House Conditions Are Variable

The tank-house production is dependent upon the amount of copper dissolved from the ore, which varies considerably, and the current density is varied to satisfy this condition. Within certain limits a reduction in current density is accompanied by a lower power consumption. The power represents approximately 80 per cent of the total tank-house cost.

The strength of copper, acid, ferric sulphate, and other components cannot be held at some predetermined figure, for several reasons. Sometimes the copper content must be dropped below the desired strength to satisfy production requirements, and acid strengths are regulated to satisfy the acid consumption in leaching. The entire process is built around the efficiency of manufacture of ferric sulphate in the tank house, and of course ferric sulphate is extremely detrimental to tank-house efficiency. A general manipulation of solution, together with the arrangement to heat solution, either preceding or following electrolysis, constitutes a control of the ferric sulphate balance. The copper solution entering the tank house is naturally best for electrolysis in the first section and poorest in the last section.

Average Tank-House Results

Three Months' Average, Spring of 1928

Section	Current Density	Voltage	Ampere Efficiency	Kw.-Hr. A.C. per Lb. Cu	Ferric Iron, Grams per Liter	Temp., Deg. C.
1	11.4	2.32	71.84	1.409	5.4	33
2	11.4	2.29	70.27	1.432	6.7	34
3	11.4	2.27	69.58	1.430	7.8	35
4	11.4	2.26	66.97	1.474	8.6	36
5	11.4	2.25	65.00	1.516	9.2	37
6	11.4	2.25	64.19	1.538	9.6	38
7	11.4	2.23	61.61	1.579	9.9	39
8	11.4	2.22	59.74	1.629	10.2	40

Sampling of the copper bullion is done once a month, which serves as a control and a check on refinery results. A typical analysis follows:

Electrolytic Copper

	Per Cent		
Cu	99.66	Se and Te	Trace
H_2O	0.075	Cl	Trace
"Insoluble"	0.040	Zn, Ni, and Co	Trace
Fe	0.017	Sn	Trace
Pb	0.016	Ag, oz. per ton	0.045
S	0.012	Au	Trace

Electrical Losses—Because of the single-circuit tank house, the circuit is opened at specified intervals, at some point distant to the generators, and the voltage brought to an operating level. The leakage is then measured directly in power, and it has not so far exceeded 1.0 per cent with a voltage as high as 350 volts, which is a 9.4 per cent generator overload. A complete survey of the tank house shows an electrical loss of 0.62 per cent, caused by copper busses and a contact loss of 0.87 per cent.

The tank-house personnel consists of 50 men, which includes all help for the starting-sheet section as well as for the commercial section. It is capable of handling 150,000 lb. of commercial copper and 25,000 lb. of starting-sheet copper, or 175,000 lb. of copper, per day for shipment. This represents 3,500 lb. of copper per man per shift.

Iron Launders—Owing to the greater cost of producing cement copper than that of producing electrolytic copper direct from solutions, it is desirable to make as little cement copper as possible. Nine double-section iron launders, 60 ft. long and 20 ft. wide, with an average solution depth of 5 ft., are used in this service. Baled tin cans, having an iron value of approximately 92.5 per cent, are used as a precipitant. Only copper from wash waters is precipitated as cement copper, and as the surge tanks are of sufficient size both preceding and following this plant, this operation is continuous. The solution flow in the tanks is in series and the distance of travel is regulated so as to remove practically all of the copper and at the same time preserve as much of the acid as possible.

A traveling gantry crane spans the entire plant. By means of an electromagnet, cans are unloaded from railroad cars and placed in storage or directly in the iron launders. When a section of the launder reaches a point where precipitation has practically stopped, the solution is drained through weep holes and excavation with a clamshell bucket is started.

In separating the undissolved cans from the cement copper, a trommel 12 ft. long and 5 ft. in diameter and revolving at approximately 13 r.p.m. is used. Holes ¾ in. in diameter permit the cement copper to fall into a sump while the undissolved cans come out of the lower end of the trommel to another sump and are returned to the launders. A pipe extending into the trommel washes the cement copper through the holes into the cement-copper sump. The water overflows to a pump and returns to the trommel. The cement copper is loaded from the sump with the clamshell bucket to cars and is shipped to the smelter.

In some leaching plants that are not attempting to dissolve sulphide, the ferric sulphate is kept reduced to as low a point as possible so as to secure high electrolytic efficiency. At this plant efficient operation requires that the ferric sulphate in the solution used to leach the ore be kept as high as possible economically, and the solution of cement copper by ferric sulphate reduces the quantity of this solvent to such an extent that it is necessary to ship cement to the smelter irrespective of cost. In most leaching plants, iron launders are used for handling discard solution. There being no discard at this plant, the metallurgical purpose of iron precipitation is to assist in maintaining the desired iron-strength in leaching solutions, and allowing a cleaner wash of leached tailing with a minimum addition of fresh water. The following will show some general results:

	Lb. Iron Consumed per Lb. of Cu	Lb. Cu Precipitated per Ton of Ore	Cu in Solution to Launders, Grams per Liter	Cu in Solution From Launders Grams per Liter
1927	1.924	3.27	3.63	0.23
1928	2.054	2.77	3.01	0.15

This entire division, which handled 18,717,601 lb. and 17,322,260 lb. of baled scrap iron in 1927 and 1928 respectively, as well as 9,728,483 lb. and 8,433,989 lb. of cement copper in 1927 and 1928 respectively, was operated by one craneman and three Mexican laborers. Any repair work necessary is handled by another department. The consumption of iron seems very high, but this is caused by high percentages of acid and ferric sulphate in the solution going to the launders.

The officials of the Inspiration Consolidated Copper Company who were in active charge of operations during the development of the process and the successful operation of the plant were: Dr. L. D. Ricketts, formerly president and now consulting engineer; Mr. W. D. Thornton, president; Mr. William Wraith, vice-president; Mr. T. H. O'Brien, general manager; Mr. C. E. Weed, assistant general manager; and Mr. G. D. Van Arsdale, consulting metallurgist. The plant was designed by Mr. A. G. McGregor and constructed under the supervision of Mr. G. H. Booth, mechanical engineer of the company.

Antimony Mining Costs Increase

THE POSITION of China in the world situation in antimony has in recent years been continually noted, writes K. C. Li, in an article on Antimony in the current issue of *The Mineral Industry*. With her practically unlimited high-grade ore reserves and especially low labor and other mining costs, China can produce antimony much cheaper than any other country in the world. As an illustration China actually produced and sold antimony at somewhat less than 4c. per pound, c.i.f. New York, during 1921 ad 1922. However, such a low price will probably not be reached again, as the production costs in China have in the last few years been increased tremendously. The producers now have labor unions to contend with, and the laborers now receive much higher wages with shorter hours and better working conditions. This, together with increases in freight rates, export taxes and general expenses, has added to the cost of production considerably. In the near future the Chinese government will probably add a new export tax on antimony, as on other commodities, for revenue purposes.

The condition of the industry in China is still far from satisfactory. Mining operations are all on a modest scale, and the business is carried on in the same old-fashioned method. Producers are made up of numerous small operating groups, with practically no organization. A few new schemes have been proposed and attempts have been made to control production and stabilize the market price, but up to the present time none have been successful.

FOR DISTINGUISHED SERVICE TO THE MINING INDUSTRY

CORNELIUS FRANCIS KELLEY, president of the Anaconda Copper Mining Company, which is the largest single factor in the non-ferrous metal mining industry of the world, was presented with the gold medal of the Mining and Metallurgical Society of America, at the Hotel Savoy Plaza, in New York City, on Tuesday, Oct. 22. This award is made annually for distinguished service to the mining industry. In accepting the award, Mr. Kelley declared that he could not express the depth of his appreciation, particularly since he was deeply sensible of its import and of the obligation it imposed on him to further the progress of the mining industry, into which he had been born. Deeply grateful as he was for the distinction, however, Mr. Kelley averred, he prized even more highly the friendship and esteem of his colleagues and associates, as manifested by their presence and by their generous words.

On behalf of his associates, Mr. Kelley thanked the speakers who had referred to the progress made by the Anaconda company. He pointed out that the co-operation, loyalty, and devotion of the staff were the true cause of that progress. This spirit of co-operation existed not only within individual companies but indeed throughout the entire industry, he declared. Otherwise, no real progress could have been made. After these introductory remarks, Mr. Kelley continued as follows:

THE ART OF MINING is undoubtedly one of the most ancient, honorable, and useful pursuits of man. The narrative of his evolution from a primal state of helplessness is told in, and its chapters are measured by, the development of his capability to extract and adapt to his use the mineral substances of the earth.

Back of the curtain that shrouds the past the evidentiary fact that there had come on earth a being who was destined to become its master is disclosed by primitive tool or weapon, the sole surviving tokens found where once this unknown and solitary creature had his abode. We know not definitely his origin, his habits, or his attributes. We do know that he and he alone, of all the creatures that lived and fought for survival, possessed the faculty to take from mother earth its substance and utilize it for his necessities. It was the power to call to his assistance the product of mine or quarry that enabled him to survive in an environment where otherwise he must have perished. So the constant application of this faculty through the ages that were to pass made it possible for him to emerge from a state that of necessity would have ended in oblivion, through a progressive development, toward the status we term civilization—the result of which was the development of commerce, industry, art, and science: in short, of social organization.

It is a noteworthy fact—worthy of more than passing observation—that no people have left an enduring impress upon the record of the past, nor made a lasting contribution to civilization, who did not possess and utilize a supply of mineral wealth.

Throughout the past the standards of life have been, as they are today, fixed by the available supply and applied use of mineral and metal products. From them were fashioned the implements that made agriculture possible; the tools that felled the forest; the weapons that gave to physical inferiority the powers of offense and defense. Their acquired use enabled man to emerge from the gloom of the cavern and to erect an abode in the sunlight.

There is no vain conception of the importance of the mining industry to the economic status of mankind in asserting that it has been a necessary adjunct to every phase of man's existence, indispensable to every step in his development. Success in combat, achievement in peace, have been alike dependent upon it.

If this epitome be justified as applied to the past, of what transcendent importance has the proper administration of the various branches of mining become to the contemporaneous demands of the industrialized era in which we live.

How many outside of those directly engaged in the metal industries realize the service rendered by them daily to all who live within a modern environment, and the extent to which all who enjoy the conveniences that are at our command are indebted to the work of the miner and the product of the smelter.

NO PERIOD of man's existence has been attended by such profound changes in his social and economic status as the present, nor to the people of any land has there ever come such an advance in the standard of living as has been and is now being experienced by the inhabitants of the United States.

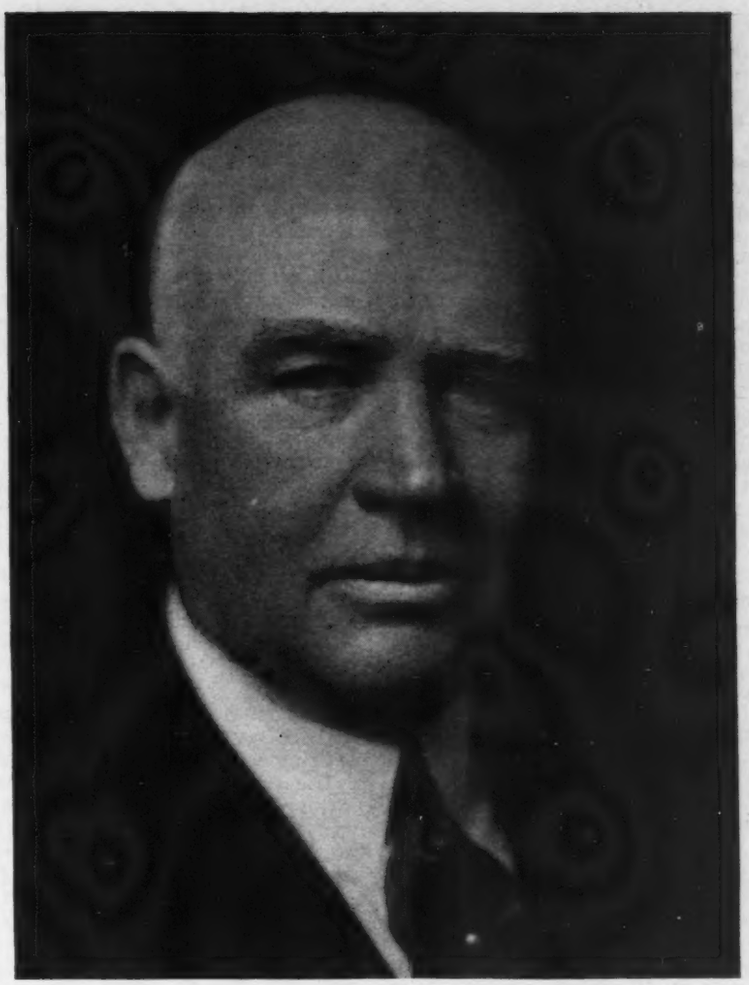
The simplest analysis of the basic causes that underlie this enviable position must recognize the supreme importance which the mines and mining products of the nation contribute as essential factors to this development.

The fascinating story of the industrialization of America and its effect upon the civilized world presents an entirely new chapter in productive effort and beneficial consequences. The manner of its conduct and the magic of its development have destroyed the old conception that a life of trade in-

volved a monotonous existence of humdrum work and dreary routine of detail. The status which it occupies today, and its future possibilities, appeal to the comprehension of the most imaginative. Industry presents to its followers elements which, if lacking in romance and adventure, furnish, nevertheless, opportunities for the exercise of the most energetic and capable qualities with which man is endowed.

Within the memory of most of us here gathered extraordinary changes have occurred in the methods of production, manufacture, transportation, and distribution. What a radical evolution has this brought about in the lives, the habits, the labor and recreation of the average man and woman! The entire economic aspect has been changed, not alone from the viewpoint of those who lead and direct great industrial organizations, but down through the ranks to those who perform its laborious if simple tasks.

Business has broken away from the traditions and practices of the past, and has been established upon the basis of new ideas and endeavors. Such profound changes could not have occurred —they would have been impossible— had it not been for the potentialities which existed in the superabundant supply of raw material with which this country has been blessed, the possession and utilization of which not only formed the basis for its present supremacy, but also underlie its future possibilities.



CORNELIUS F. KELLEY

TOO OFTEN is the fact overlooked that the rise of our country to its present position of supreme political importance and unrivaled industrial power could not have been achieved without its deposits of coal, oil, and iron; its mines of copper, lead, and zinc, of gold and silver. These constitute in final analysis the storehouse of the nation's treasures, and upon their proper administration and utilization our industry may live, our commerce grow, and our national existence be maintained.

In giving expression to this thought I hope that I may not be judged as entertaining a too narrow or nationalistic conception of the mining industry, or of the duties and responsibilities of those who are engaged in its conduct to other than ourselves. America has contributed far too generously of its metal wealth to the requirements of all the world to be deemed guilty of any selfish hoarding in this respect.

Revolution of method and evolution of practice in the contemporaneous epoch have exercised no more complete change in any industry than in that of the mining and reduction of non-ferrous metals. The colorful era that witnessed its inception and early development has passed. The prospector, so well remembered by many of us, who, with his grubstake on one burro and his mining equipment upon another, confidently set forth, blazing the trail through remote forests, penetrating the unsurveyed canyon in search of paydirt along the creek bottom, staking out a superficial lead, which, to be of value, had to pay from discovery, has joined that phantom group—heroic figures of the past, precursors upon land and sea —whose deeds are told in legends, but in whose efforts was the genesis of the greatness that was to follow.

The windlass, whip, and whim of the pioneer miner, operated to shallow workings, have given way to huge electrically driven hoists which enable penetration to unthought-of depths below the surface of the earth.

Motors now move trains of ore through drifts far below those through which the carman pushed his tiny load. The primitive arrastre and noisy dropping stamp have been superseded by the huge mill where carload lots instead of barrowfuls are fed to crushing, grinding, and separating mechanism. Furnaces, scientifically fed and regulated to exactitude, reduce in daily charge to molten metal an output exceeding the monthly run of the prototype from which they are derived.

It is not, however, in mere size of operating units that the most useful progress has been made, but rather in that combined achievement of the miner, the engineer and the metallurgist which has brought within the scope of profitable beneficiation enormous tonnages of metal-bearing material considered valueless so brief a time ago.

THIS HAS BEEN the basic condition that has made possible the industrialization of an occupation that had always been regarded as one of risk and hazard. It is the outstanding accomplishment contributed to by so many of those here present, and without which the world today would be unable to obtain an adequate supply of those metals indispensable to its progress and development.

The amount of capital now required, the long construction period, the necessity for organizing staffs of skilled technicians to study and solve the difficult problems incidental to every large mining operation, have resulted in the inevitable forcing of the individual operator into the background. To a great extent he, too, has followed the trail of the prospector. The organization of mining as an industrial undertaking has become a necessity to its continuance; its problems must now be studied from that angle, rather than from the standpoint of temporary advantage of one mine or one group over the other. No

unit is so fortunately situated that it can long be prosperous unless the industry as a whole is in a healthy condition.

The time has passed when the mining, milling, and smelting of ores, the refining of metals, and the fabricating of products can be regarded as wholly independent branches of industry. On the contrary, they are in my opinion mutually dependent upon one another, and none can be conducted successfully unless all share in a common benefit proportionate to the risk involved, the service rendered, and the result obtained. Methods that tend to isolate one branch of the business from another should be revamped. Customs that rely chiefly upon tradition to command them should be forgotten. The ultimate purpose of the industry, that of furnishing the necessary metals to ultimate consumers in adequate quantity at reasonable prices, should be the objective toward which constructive action should be and must be directed. Those conversant with the subject cannot feel that the problems of marketing and distribution have been solved as effectively as have those of mining and extraction.

VERTICAL INTEGRATION of the productive effort from the mining of the ores through the successive stages of reduction, refining, and manufacture, to the ultimate sale and distribution of the product, would seem to be a logical sequence, and one which, I believe, rationally exercised, will result to the benefit of all concerned. Complete integration may be impossible, and perhaps is not to be desired; but it is incompatible with the attainment of the best results that through the various stages of what should be a united and co-ordinated effort, any great proportion of the product should continue to pass from one hand to another where there may be not alone a lack of sympathetic purpose but to a greater or less extent diverse and conflicting interests.

Whatever may be the moral responsibility of those who are engaged in other industries, and few only are they in which this attribute does not apply, I cannot help but feel that a singular responsibility applies to those charged with the duty of administering the mining industry. This fact arises from the inherent character of the occupation and is inseparable from its pursuit.

THE ultimate result of working every mine is its exhaustion. The more efficient the operation, the more completely is the earth robbed of an irreplaceable and irrenewable deposit of wealth. It should therefore be made a duty to conserve to the fullest extent consistent with economic need the known mineral resources of the world.

Waste, the inevitable result of selective mining, should be avoided, and the vice of overproduction, resulting in the dislocation of markets, widely fluctuating prices, and chaotic conditions throughout the industry, should be penalized as an economic crime, instead of being compelled as a civic obligation.

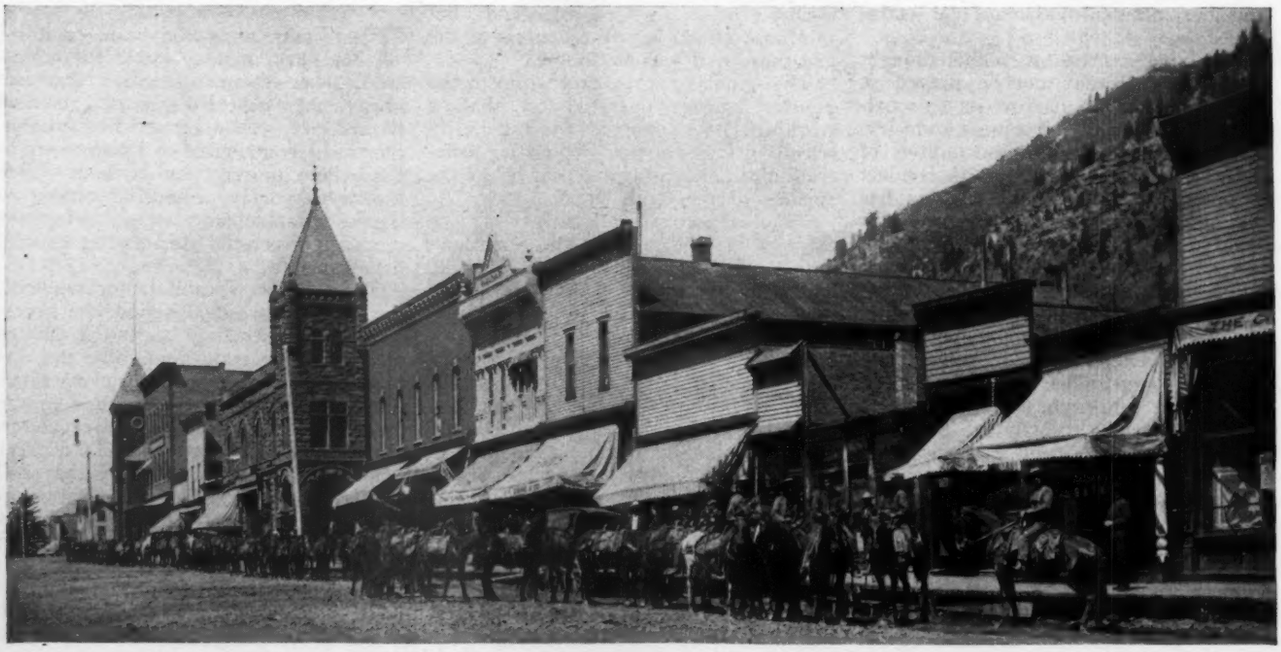
The archaic conception that a necessary protection to society demands that men should be deprived of the right to exercise a common intelligence in the production and distribution of the products of natural resources should be relegated to the oblivion that enshrouds other discarded vagaries that once possessed the dignity of statutory enactment.

No sensible person contends that the public is not entitled to protection, or that unrestrained liberty of action might not lead to abuse. So long as a desire for gain is an impelling motive to human action, so long must a regulatory control be exercised in the interest of the common good; but no rational philosophy can justify the absurdity that compels a continual glutting of markets with an unabsorbable surplus, or that prevents the exercise of a rational co-operation, not for the purpose of fixing exorbitant prices, but to establish a reasonable equation between supply and demand, to the end that mining properties may be properly operated in the public as well as private interest, the risk of fluctuating markets averted, labor be given stable employment, and prices prevail which, if assured, can be established upon a reasonable basis, fair alike to producer and consumer.

Surely this problem is of utmost importance and should command the effort of those engaged in the industry.

MR. PRESIDENT, I realize that this occasion does not call for an elaborate discussion of the mining industry, its problems, or its destiny, and I have no desire to trespass upon the proprieties. I have always felt that it was a fortunate circumstance for any man whose lot was cast among the mining fraternity. Tonight I am more deeply impressed with that fact than ever before. I shall always prize this medal, and I shall always cherish the recollection of this night. It, and they, will ever be an incentive to endeavor within my capabilities, and, to the extent that opportunity is presented, to work for the advancement of the interests of that industry to which I owe so much and to which I am tonight, through your generous action, placed under an additional, deeply felt obligation.

A 75-mule pack train in Telluride, Colo., when the town was young and the first San Juan "boom" was under way



Electrical Service

At United Verde's Clarkdale Plant

By A. I. GREENWOOD
Chief Electrician, United Verde Smelter, Clarkdale, Ariz.

THE amount of electrical equipment used in a large mine, mill or smelter under present-day conditions is altogether different from what it was 25 years ago. Then the lighting features and a few motors constituted the electrical equipment. Today electrical equipment is conspicuous on every hand. The power for the Clarkdale plant of the United Verde Copper Company is furnished by a steam-driven generating plant, and also by the Arizona Power Company, the two systems operating in parallel the greater part of the time. Most of the steam is generated by waste heat from reverberatory furnaces, but two oil-fired boilers can also be cut in to furnish additional steam when needed.

The generating equipment consists of two 6,000-kw. and two 2,000-kw. turbo-generators. Power is supplied to the mine and also to the tie with the Arizona Power Company through a 6,000-kva. transformer bank stepping up from a generated voltage of 2,300 to a line voltage of 44,000. Distribution within the Clarkdale plant is at 2,300 volts, three phase, to four substations placed at various load centers in the plant. From the substations, distribution, at both 2,300 volts and 460 volts, is through underground conduits, which extend from manhole to manhole. In the plant are about 25 manholes.

All alternating-current motors of 50 hp. and over are operated at 2,300 volts; those under 50 hp. at 460 volts. In addition, many motors taking less than 1 hp. operate from the lighting circuits. The overhead cranes in the converter aisle, all haulage locomotives, and several shop cranes are operated on 250 volts, direct current. The total number of motors in the plant is about 500, and the connected horsepower about 17,500, exclusive of fractional-horsepower motors.

Slag haulage is effected by two 25-ton electric locomotives and one of 18 tons. Ore for the blast furnaces is hauled from the storage bins by two 10-ton electric locomotives. Hot calcines are hauled from the roasters to the reverberatory furnaces by two 10-ton locomotives. In addition one 18-ton and one 10-ton locomotive are held in reserve and for extra work. The traveling cranes for handling the ladles in the converter aisle are 40-ton units, each equipped with two hoists. Dust is removed from the smelter waste gases by a Cottrell installation, which uses rectified alternating current at a potential of from 50,000 to 70,000 volts. Most of the conveying of material is done by belt or screw conveyors; and, where elevation is necessary, by bucket elevators.

The electrical maintenance work as well as installation of electrical equipment at this plant are in accordance with several objectives or ideals. The four most important are (1) safety, (2) continuity of service, (3) convenience, and, (4) economy. Safety is a fundamental requisite of all industrial operations. Any plant with a bad accident record cannot be considered successful, no matter what the apparent results in production. Safety should therefore be the first consideration, not production. The training of men for safety and the installation of safe equipment are continuous, for no matter how much has been accomplished in the past, additional refinements and improved equipment become available from time to time.

About seven years ago, when safety work was first started at this smelter, many electrical hazards existed, such as open knife switches, even 2,300-volt switches, and exposed wiring. At that time no safety knife switch could be found in the plant; that is, one which could be operated by a handle on the outside of an inclosed case. With the exception of power-house and substation switchboards, there is now no open-knife switch in the plant except in a few lighting circuits, and these are all soon to be changed to safety switches.

All underground circuits are tagged in every manhole, the tags giving voltage and service of each circuit. Switches, circuit-breakers, panels, starters, and machines are labeled in good, legible letters, usually in yellow paint so as to prevent accidents arising from a connection with the wrong circuit. A complete set of maps shows all circuits, with numbering to correspond to that in the manholes.

Accidents have occurred through improper use of manually controlled starting equipment. Many starters have been changed during the last few years from hand to automatic control, and practically all new equipment put in is automatic. All 2,300-volt manually operated, reduced-voltage starters have been equipped with a boiler-plate guard in front, with a rod attached to the operating handle, extending through the guard. Since these guards were installed, two starters have blown up, but in neither occurrence did injury result to a workman.

All distribution lines in the plant are in conduit, except the over-head trolley system, yard lights, and two short stretches of feeder lines. The policy now is to have all wires protected by conduit right up to the motor frame, using a steel or iron box in which to make connections to the motor. All 2,300-volt motors in the plant are now so protected, but many 460-volt motors still have exposed wires from the conduit outlet to the motor. All of the

460-volt motors will eventually be equipped with conduit boxes.

In the installation of new equipment, care is exercised to have all parts needing inspection or repair provided with plenty of room and conveniently arranged. One important requirement for safety in any plant is good lighting. During the first two years of our safety campaign the lighting of nearly all parts of the plant was reorganized. A foot-candle meter proved to be of considerable service in determining proper lighting in various sections of the plant. At present the lighting is good in all departments and complies with the major safety conditions.

For the safety of the men in the electrical department, rubber gloves are provided for all "hot work." These are tested at regular intervals. An iron-clad rule insists that whenever hot work is to be done on any circuit over 110 volts, at least two journeymen electricians shall be on the job. "Square D" voltage testers are used for all low-voltage testing, test lamps being considered very dangerous. For testing 2,300-volt circuits, a tester made up of a potential transformer and lamp mounted in a box is used.

The men are given good material and good tools with which to work, and are urged to keep their tools in good repair. The safety idea is strengthened by having the men of the electrical department get together in a "safety meeting" at least once in two weeks. A safety bulletin board upon which new posters are placed every few days is maintained. The number of men employed in the electrical department is about 25, and they are all proud of the fact that for one year and ten months to date no lost-time accident has occurred.

Continuity of electrical service is of prime importance in an industrial plant, and especially in one where a flow of materials through the plant takes place at a steady rate. A few minutes' delay on one machine may cause a production loss for a whole department. To guard against costly delays owing to failure of electrical equipment, several methods are in use. One of the most important of these is duplicate service, which is maintained in regard to practically all important drives in the smelter plant. Beginning with the generating equipment, two large and two small generators are available. One large and one small machine can carry the total load. In the power house are two generator buses and two distribution buses.

The transmission line to the mine consists of two circuits. An extra step-up transformer in the transmission line supplying the mine is so arranged that it can be connected in the place of any one of the three in service by the simple expedient of throwing switches. Two circuits feed the converter cranes. The converter tilting motors are similarly served, and each motor is equipped with a double-throw switch, so that it can be connected to either line in a moment. Duplicate lines also supply the crushing plant and concentrator. In many places, where considerable time would be lost in changing motors, two motors are permanently mounted in place, the spare motor being placed in service by simply putting on a belt and changing connections to the circuit. This arrangement is used for the motors driving the pulverized-coal burners supplying the reverberatories.

Four sets of power transformers in various substations, furnishing 460 volts, are arranged for interconnection on the low-tension side. In this way all 460-volt circuits can be kept in service, even though one of the transformer banks is out of commission.

Provision for necessary spare parts and a knowledge of where they are is also important when it comes to giving uninterrupted electrical service. For equipment that is used in various parts of the plant, spare parts are kept in the warehouse. For electrical equipment that requires special parts, such parts are kept in a locker conveniently placed near the equipment on which they are to be used.

One factor that is important in preventing delays is a good system of records. We have a complete data file covering all electrical equipment, and we use one large manila envelope for each drive. In the envelope is complete information on the drive. One card has complete name-plate data of the motor and such necessary information as bearing sizes, and grade and size of brushes. On the card is indicated what spare parts should be kept in stock and where they are to be found. A similar card is made out for the control equipment. The envelope also contains complete drawings of the control equipment and records of any tests which may have been made. Such a system of records is of importance in keeping an adequate stock of spare parts and also gives the maintenance electrician complete information about the equipment. This is a necessity on automatic equipment when "shooting" trouble. Besides these records on the various drives, maps of the distribution systems are also provided.

Probably the most important factor in giving continuous service is thorough maintenance. We have found that the best method for accomplishing this objective is to give an electrician a certain part of the plant to inspect and maintain, and then to hold him responsible for keeping his equipment in good operating condition. All of these men are on bonus. Some are paid a flat bonus of 25 per cent, with deductions for delays. Others participate in a departmental bonus, based on the cost of production for the month.

Another factor which helps in maintaining continuous service is that of proper equipment. If a particular type of equipment gives considerable trouble, and a newer and better type is on the market, to discard the obsolete equipment and install the new is often a profitable procedure. The most notable example of this fact in this plant is in the use of contactors equipped with thermal relays in place of fuses, or in place of oil switches, released by dash-pot type of overload relays.

Convenience of operation of electrical equipment is thought to be worth while. We are slowly appreciating the fact that happy, contented employees are a valuable asset to any establishment. A machine that is easily operated helps to keep the operator in such a state of mind, and also means an increased output. In line with this idea, all new equipment installed during the last three years has full automatic control. Instead of the operator's being required to remember a certain sequence of operation of various switches, to press a button is all that is necessary. Much of the old equipment which has been changed over to give more reliable service also gives more convenient operation. Properly placed equipment is also important. In installing any new equipment the operator is always kept in mind and the equipment is arranged for his convenience.

Accessibility for inspection and repair should not be overlooked. An electrical installation that is crowded is not only inconvenient for the repair man but is a hazard that may cause a serious accident. Signals and interlocks

add greatly to convenience of operation. These will be found almost everywhere, from one end of the plant to the other.

Proper maintenance, which was mentioned under continuity of service, also helps in giving convenient operation. Nothing is so aggravating to an operator as a piece of equipment that is out of repair.

Economy of operation is, of course, a most important factor in the operation of any industry. It is the measuring stick which indicates whether the industry will continue to do business or whether it will eventually succumb. The foregoing phases of electrical work tend to lower costs. Safety always pays. Accidents always increase cost. To secure continuity of service increases the cost, but delays would involve a greater expense. By the use of conveniently operated equipment, more tonnage can be put through the plant in a given time, and this is an important factor in lessening labor costs.

Probably the largest item of cost of the electrical department of any plant is repairs, and along with this is the cost of the delays which occur when a machine fails. To keep repair costs down to a minimum, each maintenance man is required to make out a daily report. In this way any equipment that is giving trouble can be quickly identified and the cause of the trouble investigated. Some causes of trouble which have been remedied are tight belts; bearings not properly protected against dust; overloaded equipment; and excessive dust. To overcome the last-named trouble, a system of forced ventilation is being used for some of the larger motors in dusty positions. Line transmission losses are an important item, and these have been reduced by the installation of synchronous motors, and in the transmission line to the mine such losses have been diminished by means of a synchronous condenser. Transformer-core losses are important, and they are kept to a minimum by proper loading and by shifting the load from one bank to another as required.

About 230 watt-hour meters measure the power used throughout the plant. The flow sheet is arranged to show all line and transformer losses. If any of these losses are high at the end of the month, the cause can be investigated. The cost of power at the switchboard has been reduced by the installation of turbine generators with a water rate of 14 lb. per kilowatt-hour as compared to 19 on the old turbines.

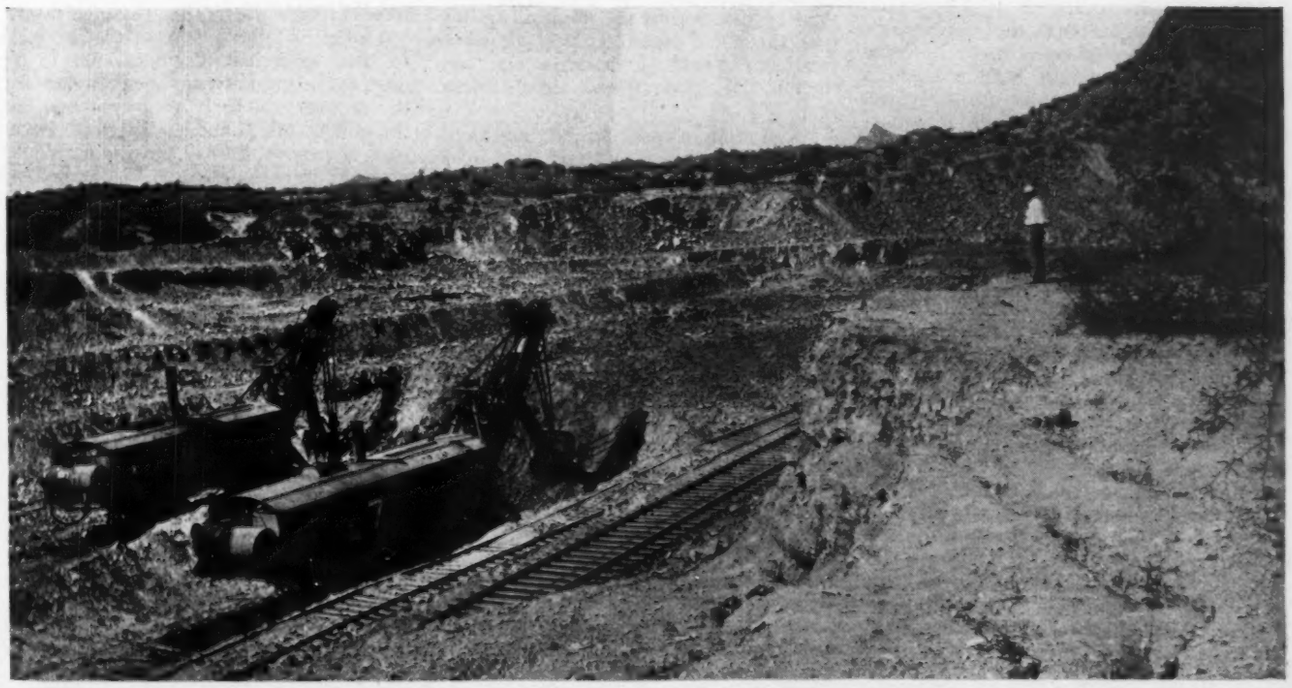
The cost of original installations is being reduced by installing motors which will start directly across the line wherever possible. This greatly cuts down the cost of starting equipment. The largest motor now started on full voltage is a 350-hp. self-starting synchronous motor driving a ball mill.

The use of new types of equipment in place of old is also important. A few illustrations are Rectox rectifiers in place of wet-cell batteries; new-type magnetic brakes instead of old; thermal-overload relays in place of the magnetic type; line starters in place of oil switches and fuses; and moulded rubber cords for extension lights and portable tools, instead of packing-house cord. Such automatic features as float switches, interlocking of conveyors, and automatic starters all reduce operating costs by making possible a reduction in the number of operators needed.

In investigating means of reducing costs, standardization should not be overlooked. Standardization in this plant has been carried out in motor brushes, resistance grids, lamp sizes and voltages, lighting fixtures, condulets and motor speeds.

The men who comprise the electrical department of the Clarkdale plant of the United Verde Copper Company feel that they have a large responsibility and are a vital factor in the organization. Their desire is to cooperate in every way with all other departments and to bring the electrical department to as high a standard as possible. This attitude in itself is likewise an important factor in cost control.

Open Pit at Chino Mines of Nevada Consolidated in New Mexico



COMMENT AND CRITICISM

Preliminary Impoverishment and the Simplification of Gold-Ore Treatment

A FURTHER DISCUSSION of problems in gold-ore treatment, prompted by the views of Mr. Charles Butters, published in our issue of Aug. 31. . . . Mr. Hamilton, writing from San Francisco, questions the advisability of a complicated flow sheet, involving flotation, roasting of concentrate, and cyanidation of tailing, as compared with straight cyanidation. . . . What constitutes "impoverishment"?

To the Editor of "E.&M.J.":

Referring to the letter of Mr. Charles Butters in your issue of Aug. 31, I think it will be generally conceded that plate amalgamation has its economic drawbacks, and that the individual circumstances of each mill largely will determine on which side the balance tips. In the concrete instance of San Albino, given by Mr. Butters, I think his point in regard to preliminary amalgamation may be taken as proved.

On the other hand, I question the correctness of his conclusions as to the rest of his scheme of treatment. While thanking him for his expressions of belief in the ability of Hamilton, Beauchamp & Woodworth to perform what they prognosticate, I wish to state that the guarantee of extraction mentioned by him applies only to material of identical character with that on which we experimented. The only sample available at the time of the tests (and up to the present) assayed over $31 per ton, whereas Mr. Butters gives his probable run of milling ore at $10 to $12 per ton. Moreover, we have reason to think that our sample contained less of the objectionable carbonaceous matter than did the average ore, though we have no direct evidence of this. However, notwithstanding those differences, we feel confident that the run-of-mine ore at the San Albino can be made to yield a comparatively high extraction (though perhaps, or even probably, not 97 per cent) by the simple modification of ordinary cyanidation we have worked out.

If this latter proposition be assumed (and Mr. Butters seems ready to assume it), surely there is no comparison between the simplicity of the two methods.

After fine grinding, which would probably be common to both, Mr. Butters floats, making a concentrate and a tailing. The tailing he apparently intends to cyanide—an operation that will need almost as large a plant and almost as much attention as a plant to treat the original ore. Next, he has his concentrate to dewater, dry, and roast. And this roasting operation, to be done by hand, does not seem so simple either. One wonders what his native staff will make of it. Then, presumably, he intends to cyanide this roasted concentrate. He does not explain whether it is to be treated in a separate small plant or fed into his large plant with the flotation tailing. Hardly the latter, I think. If not, he has two separate cyanide plants to be looked after. All these various stages and departments are to be run by one white mechanic, "married to a good Latin-American woman," without technical training, and assisted entirely by natives.

Regarding straight cyanidation of this ore by our method, I will venture the statement that it would require no greater skill and little more attention than cyanidation of the flotation tailing, with the added advantage that the whole treatment would be done in one continuous and comparatively simple operation.

As to relative costs, no data are available. Inasmuch as we have not made any tests on run-of-mine ore, we are not in a position to estimate costs or residue losses in our method. But Mr. Butters himself has not given us any estimate of the complete operating costs of his scheme, nor of his losses in handling concentrate—as, for example, spillage, dusting, pilfering. To a workingman of Central America, $300 material, already prepared for the recovery of the gold, would be considered well worth pilfering. And, last but not least, he gives no estimate of the loss of gold in the residue.

In the absence of definite figures on both sides, his scheme apparently could not begin to compete with ours in the matter of economic results. Even should the costs of the two schemes approach closer to each other than seems likely at present, I am sure Mr. Butters himself would be the first to admit that errors and "grief" in operation may be the cause of heavier losses in a single day than would be suffered in a year as the result of a slightly higher operating cost per ton, even though he may not admit that his scheme is more likely than ours to be productive of such sporadic losses, as we hold to be the fact.

Mr. Butters remarks, in passing, that his method of treatment follows the editor's dictum on preliminary impoverishment, inasmuch as he uses "impoverishment" before final treatment. But is this really so when one analyses his procedure? He takes a certain material containing a known amount of gold per ton; he divides this into two parts, a major and a minor; he impoverishes the major part, certainly, but what he subtracts from that he adds to the minor part; both parts are destined eventually to be cyanided for the recovery of their gold contents. At the end of his "impoverishment" operation, therefore, he has the same amount of gold remaining to be recovered as was contained in the original material. The only difference is that there are two products to be cyanided instead of one product, with the original quantity of gold divided unequally between them. This, I think, is not "impoverishment" within the meaning of the present discussion.

E. M. HAMILTON.

San Francisco.

An Oversight Corrected

To the Editor of "E.&M.J.":

In your issue of Sept. 28 appeared an editorial entitled "An Alloy Age Looks to the Mining Industry for Raw Materials."

We are in entire agreement with the thought expressed, but we feel that

molybdenum should not only have been included, but should have had a prominent place in the list of the chief metals cited as being used in the production of alloy steels and irons. You are familiar with the large tonnages of molybdenum steel being made both here and abroad, and, no doubt molybdenum was omitted from the list only by an oversight.

ALAN KISSOCK,
Climax Molybdenum Company.
New York.

Getting the Most From "E.&M.J."

To the Editor of "E.&M.J.":

The economical binding described in the editorial of Aug. 3 is a real help, but before the *young* engineer adopts it I believe he should give some thought as to how and where he is to use his magazines. If it is to be in the office, laboratory, or library at home, the bound volume is most desirable; if on the train, the boat, or in the field, binding is a disadvantage.

Before many volumes have accumulated, the engineer will very likely have some idea as to whether he is fitted for operating or research: whether he will choose some position that will allow him to live at home, or whether he is likely to be sent about from one place to another, with new problems constantly to be solved. If the last-named possibility should be the case, files of *unbound* journals are decidedly preferable.

It may be easier to lose a single copy than a bound volume, but see what you lose when the bound volume disappears! And I notice bound volumes do not always come back. However, the unbound volume can be conveniently kept in a fiber envelope 9½x12½ in. with 3-in. expansion and tape attached for tying. They cost $100 per thousand—possibly 20c. each if purchased singly. Even the advertising in one copy, usually the annual number, can be retained.

A helpful adjunct is a card index. *Tempus fugit* seems always applicable to the date of technical articles. The description of a mining district or a process which one recalls having read usually proves to be six years back instead of three, as expected. A brief index, under the proper headings, of such articles as one feels one may find useful takes only a few minutes each week. An additional line or two indicating the scope sometimes helps, and saves digging out an article having no application to the problem on hand. I find this particularly true with the earlier of the 80 volumes I have. Even when extended to cover many periodicals, such an index rarely requires half an hour a week, though it is better written while the matter is fresh in the mind. Abbreviations must be many, and both sides of the card used, or it becomes too bulky. A typewriter that will write close to the top and bottom and ends of the cards is needed. Less than ⅛ in. all around was possible on the old Monarch. Dictation produces more bulky results than personal indexing. My 2,000 cards, which I estimate have 20,000 to 25,000 references, fill two metal boxes, each 5x10½x3½ in., with a third well under way.

Fortified with such as these, an engineer may sojourn for months where only airplanes go, and send for whatever copies of *Engineering and Mining Journal* he needs to help solve each problem as it arises.

Called upon to examine a mine in western Chihuahua, the engineer will find it convenient to glance at the cards, from which he will learn that W. S. Hutchinson wrote on it in *Engineering and Mining Journal* for March 3, 1906; W. H. Weed in *Engineering and Mining Journal* for April 4, 1908; M. R. Lamb in *Engineering and Mining Journal* for July 25, 1908; and F. H. Morley in *Engineering and Mining Journal* for April 3, 1909. These can then be put in the brief case for reading en route.

Or, when a metallurgist is called on to advise how to increase recovery at a cyanide plant where it looks as if the use of bromo-cyanide might help, he finds references in *Engineering and Mining Journal* for Oct. 24, 1903, and subsequently up to Sept. 15, 1928, all of which are easily taken along.

For such uses bound volumes require time to read, to have an abstract prepared, or carrying a heavy load. Lacking time, the result is non-use, and the engineer fails in "getting the most from *E.&M.J.*"

GEORGE A. PACKARD.
Boston, Mass.

Do you bind your copies of *E.&M.J.*? If so, you may be denying yourself the advantages of a most satisfactory method of utilizing the contents, as now described by a well-known engineer and consultant. Mr. Packard's method has the merit of simplicity and economy and efficiency. If more subscribers would classify the contents of *E.&M.J.* as Mr. Packard does, and do it regularly, they would soon realize, as he has done, the value of the magazine as an essential working tool for the itinerant mining engineer.

By the Way

New Method for Gem Identification

IDENTIFYING precious stones by means of the varied rainbow patterns they throw when examined under a "micro-spectroscope" may supplant the time-honored acid tests now employed by gem dealers. Dr. Edgar T. Wherry, of the U. S. Bureau of Chemistry and Soils, who has developed this unique test, describes the phenomena revealed by the different stones in an article in the *American Mineralogist*. He presents hitherto unpublished tables, giving the mathematical measurements of the color and absorption bands for red, blue, and green stones.

The identification, Dr. Wherry explains, is made by means of the very interesting phenomena revealed by the spectroscope. Light thrown by the gem is broken up into its component parts of red, orange, yellow, green, blue, and violet, the colors being arranged in the order of their wave-lengths as in the rainbow. The widths of the color bands vary according to the mineral substance, and the black absorption bands between the colors likewise vary, both in width and intensity.

A red stone, for example, might be glass, garnet, synthetic ruby, or ruby, worth from 10c. to $200. The spectroscope, inserted in the eyepiece of a microscope, quickly analyzes the light from the stone, arranging the color bands and black absorption bands in a pattern that reveals the true composition without possibility of error, because the patterns for no two gems are alike.

Dr. Wherry states that as far as clear, colored stones are concerned, such as rubies, sapphires, and emeralds, the new test is far more certain than the old methods of subjecting the stones to acid or scratching them with minerals, which often injure the jewel. In a spectroscope test the stone does not even have to be removed from its setting, and even a minute fragment can be identified.

Book Reviews

Are Machines a Menace or an Aid?

MEN AND MACHINES. *By Stuart Chase. New York: The Macmillan Company. Illus.: pp. 354. Price $2.50.*

MACHINES have so rapidly become by far the most important factor in the economic life of Europe and the Americas that prolonged discussion of their value and their effect on human trends is to be expected. One of the latest studies on this comparatively recent development, and probably one of the ablest, is disclosed in the book here under review, the author of which has already won the praise of liberals and progressives for other books on economic subjects.

Mr. Chase opens his discussion by considering the anatomy of machines, a process that is interesting enough as a display of erudition but is a trifle out of place in a work the significance of which is primarily economic, not technical. He then traces the history of the machine through the ages, and points out that it is by no means essential to high orders of civilization—such as those of the Greeks and the Egyptians, for instance—if cheap labor is abundant. This subject is purely factual, and few will be found who are willing to question Mr. Chase's attitude toward it. The significance of the remainder of the book, however, depends on the interpretation rather than on the facts themselves, and the careful reader will probably find much with which his own point of view conflicts.

When the author is finished—and for the reader it is an easy and rather pleasant task to follow him to that point—he sums up his findings in one short chapter. Machines have done many good things for us, he declares. The span of human life has been increased (a statement which is open to question, if infant mortality rates are not included); a larger percentage of the population enjoys higher standards of living; the scope of communication has been widened; class distinctions founded on heredity and land ownership are being leveled; hours of labor are less; superstition has been to some degree abolished; cruelty, also, is disappearing; the individual ego is frequently strengthened by direct contact with or ownership of a machine; and the "philosophy of fatigue" has been developed to a point whereby tests determine how long an individual can work before fatigue poisons reduce his output.

On the other hand, the machine has rendered the menace of war ineffably more appalling; the interlocking of industry, or what the author calls technological tenuousness, has made it possible for a small group to upset the entire social equilibrium; natural resources, particularly petroleum, are being exploited at an alarming rate; monotony in factory work constitutes a serious danger to the intellect; workmen are displaced by machines faster than they can be absorbed in other occupations without serious social disturbance; high-pressure salesmanship is adding tremendously to production costs; industry is clearly overvalued at the expense of agriculture; cities are becoming overcongested; machines have been responsible for a volume of noise hitherto unknown, and the ears and nervous system of its victims may be irreparably damaged; and the first effects of introducing the machine into a community are usually disastrous.

Some other characteristics of our machine age Mr. Chase is not willing to label either good or evil. The value of this or any similar book, however, lies in the attention it draws to what is bad. If one is willing to accept Mr. Chase's list of evil effects as essentially correct, modern man evidently has no cause to be satisfied with the civilization he has builded. The author, in a final chapter, lists the steps he would take to restore the balance if any one of several possible crises were to occur. The progressive, however, will not wait for a crisis to develop before taking action.

A careful study of Mr. Chase's list of evil effects of the machine will show that the great majority are not defects of machines or of the machine system, but of the human beings who handle them. War is a case in point; unemployment is another. The overcongestion of cities, high-pressure salesmanship, undervaluation of agriculture, and technological tenuousness all fall under this heading. Each of these defects will disappear as soon as the human beings concerned desire its disappearance sufficiently to take action. Co-operation among the nations will end war; co-operation between employer and employee will end unemployment; and co-operation between producers of any given commodity—the cigarette is a good instance—will end the necessity for high-pressure salesmanship. Electricity can stop the congestion of cities, and agriculture's problems may vanish as soon as the farmers are willing to take concerted action.

For other evil effects the machine can be held directly culpable. Exhaustion of natural resources is the most important of these, and, to the mining engineer, it is the one nearest home. Mr. Chase correctly refuses to be placated by the shirker's alternative that "substitutes will be found." Research—economic and technical—is demanded. Such organizations as the A.I.M.E. and the Institution of Mining and Metallurgy have no better or more fitting function than to bring the technician's mind and ability to bear on the opportunities for solution.

S. D. STRAUSS.

ANNOTATED BIBLIOGRAPHY OF ECONOMIC GEOLOGY, 1928. *Vol. 1, Nos. 1 and 2. Urbana, Ill: Economic Geology Publishing Company. Hereafter to appear semi-annually. Price $5 per year.*

THIS VOLUME, produced under the auspices of the National Research Council, is the first fruit of the project undertaken in 1928 after an attempt to raise a large permanent fund for a geological abstract journal had failed. From March to the end of 1928 various mining and oil companies and individuals contributed in all approximately $19,500, an amount held sufficient to provide the expenses of the work of abstracting and of the editorial staff for at least five years. The cost of printing is not covered, however, and actual publication of the Bibliography has been achieved only because The Economic Geology Publishing Company voluntered to undertake the printing and distribution, believing that income from sales would at least pay expenses. J. M. Nickles is editor-in-chief and Waldemar Lindgren is chairman of the Council's committee supervising the work. The fund is disbursed by the National Research Council.

Vol. I contains 1,756 annotated references, many of them of considerable length. They are arranged under the following heads: areal; mineralogy and petrography; technique; metals; nonmetals; coal, lignite, and peat; petroleum and natural gas (the largest section); water underground; soils and weathering; engineering geology; and geophysical prospecting. The volume has 380 pages. It is a double-sized issue. Future volumes will be sent to subscribers about March 1 and July 1 of each year.

NOTES ON THE FLOTATION PROCESS. *By R. Lord, B. M. Snyder, H. B. Menardi, S. E. Stein, and others. Los Angeles, Calif.: Southwestern Engineering Corporation. Pp. 62. Free.*

This is the second edition of a bulletin designed for the use of the flotation operator. The subjects discussed comprise: behavior of various minerals; reagents; addition agents; gangue interference; influences of soluble salts; results with different classes of ores; progress in use of collecting reagents; notes on beneficiation of oxidized ores; oleic acid; status of selective flotation; flotation of molybdenite; sulphurous acid in flotation; cyanidation and flotation; flotation machines and their function; flotation plants; flow diagrams; metallurgical calculations; typical metallurgical reports; sampling and assaying; tonnage efficiencies in flotation plants, and pulp formulas.

Personal Notes

Charles E. Addams, of Phoenix, Ariz., was in New York City recently.

Raymond Brooks has returned to New York from a short trip to Virginia.

Richard Merton, of Frankfort, Germany, is in New York City.

Robert Tally, general manager of United Verde, is in New York.

T. C. Hoelzer, formerly with Associated Metals, has become affiliated with the Metal & Ore Corporation.

Charles Bocking, president and general manager of Granby Consolidated, is in New York City.

A. K. Lobeck, formerly of the geology department of the University of Wisconsin, has been appointed a professor of geology at Columbia University.

C. K. Bain, who has charge of three of the important mining divisions of the St. Joseph Lead Company in Southeast Missouri, was in New York this week.

J. O. Elton, general manager of International Smelting, has returned to Salt Lake City from a trip to New York and Boston.

Walter Fellows, manager of Oregon Gold, operating in eastern Oregon, is also in charge of the Record mine, at Unity, Ore.

L. S. Cates, vice-president and general manager of Utah Copper, has returned to Salt Lake City from a trip to the West Coast.

Jay P. Graves, president of Constitution Mining & Milling, operating in the Coeur d'Alene district of Idaho, is in New York City.

R. O. Stokes has been appointed manager of the London office of the General Engineering Company, Ltd., Adelaide House, in King William St., London, E.C.4.

Andrew Bostain is in charge of development work at the Silver Fleet group, in the Silverton district of Colorado, which was recently acquired by a number of Pennsylvania men.

Leon Dion was elected first president of the "North of 53" branch of the Canadian Institute of Mining and Metallurgy, at the first organization meeting, held at The Pas, Man., early in October.

C. E. Bersinger, mining engineer with United Verde Copper, at Jerome, Ariz., was in New York City recently. Following a week spent at his home in Watsontown, Pa., Mr. Bersinger returned to Jerome on Oct. 26.

James M. Hill has been elected president of the Mining Association of California. Mr. Hill is engineer in charge of mineral resources and statistics for the U. S. Bureau of Mines, at San Francisco.

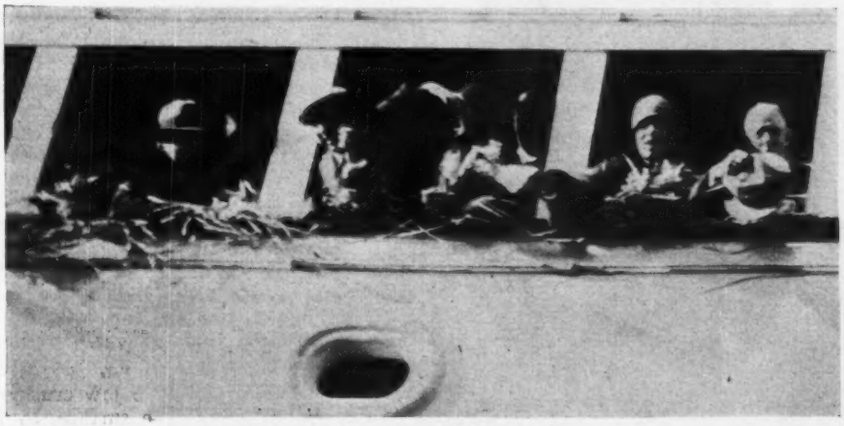
A. E. Bendelari, of Chicago, president of Eagle-Picher Lead, and **George Potter,** of Joplin, Mo., vice-president in charge of mining operations of the same company, were in New York for several days this week on business.

Bradley Stoughton, professor of metallurgy at Lehigh University, has been awarded the 1929 Grasselli medal of the American Chemical Society, for a paper written several years ago, entitled "Light Structural Alloys."

Raymond Guyer, consulting engineer for Mexican Premier Mines, has arrived at the company's property, near Mazatlan, Sinaloa, Mexico, where he has joined **R. K. Neill,** president, and **Walter J. Nicholls.**

W. C. Mendenhall, chief of the geologic branch of the U. S. Geological Survey, was in the Tonopah district of Nevada early in October. He made an inspection of the work accomplished by the Survey in co-operation with the State of Nevada.

A group of engineers and their wives leaving San Francisco on Oct. 10, on the "President Jackson," en route to Tokio for the World Engineering Congress. President and Mrs. Bradley, of the A.I.M.E., are to be seen at the extreme right.



Thomas M. Pryor, chief engineer for John Taylor & Sons, mine managers of Central Manitoba Mines, who recently returned to London from the Indian properties also managed by his company, sailed from England for Manitoba early in October.

James F. Callbreath, secretary of the American Mining Congress, has returned to Washington after a two months' trip in the West. He visited several mining camps and attended the convention of the Western division of the Mining Congress.

Arthur A. Staines has been appointed under secretary for mines (the permanent administrative head of the Mines Department) in Queensland, Australia. Mr. Staines is an officer of the Queensland public service whose long experience as mining warden on various mineral fields of that state specially qualifies him for the position to which he has been promoted.

Percival Page Butler, formerly with the Phelps Dodge Corporation as superintendent of the Copper Queen smelter, at Douglas, Ariz., has been named smelter superintendent by Sheldon Mining, which recently purchased the Southwest Metals plant at Humboldt, Ariz. Mr. Butler will direct the rehabilitation of the smelter, which will start immediately. He is a native of Montreal, Que., and was educated at McGill University, where he obtained the degree of M. Sc. in metallurgy in 1901.

Frank Childress, president of Mid-Continent Lead & Zinc, was re-elected president of the Tri-State Zinc and Lead Ore Producers' Association at a meeting of the newly elected board of directors held last week. **S. H. Davis,** manager of Century Zinc, was re-elected first vice-president, and **F. C. Wallower,** general manager of Evans-Wallower Lead, was elected second vice-president, to succeed **Edgar Wallower,** who moved to New York during the year. **Charles Neal** was re-elected treasurer, and **M. D. Harbaugh,** secretary.

Harry F. Guggenheim has been approved by the U. S. Senate as Ambassador to Cuba. After his education at Yale and Cambridge (England), Mr. Guggenheim went to Chile, where he was active in the development of Chile Copper. During the war he served as a lieutenant in the naval air force, and was decorated by the Italian government. After the war he was engaged in the affairs of several of the Guggenheim mining interests, but since the sale of Chile Copper to Anaconda, he has devoted most of his attention to matters pertaining to aviation.

OBITUARY

Edward McLaughlin, prospector in the pioneer days of Arizona, died recently at his home in Tucson. He was 79 years old.

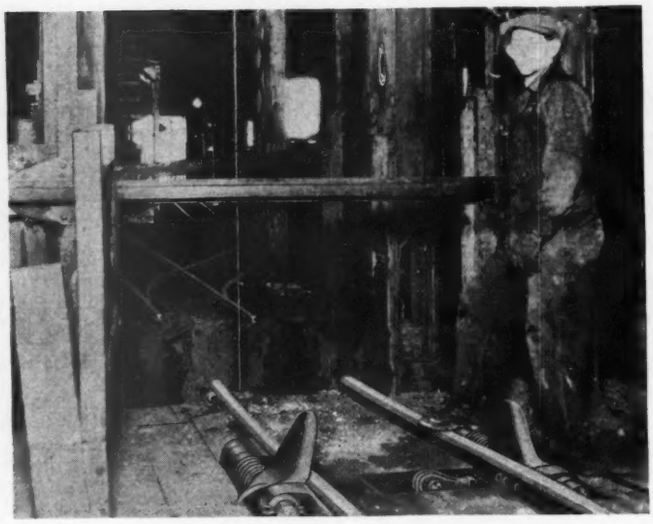
H. G. Lower, who was superintendent of the Wright Creek Mines Company, at Kingman, Ariz., was killed instantly in a recent automobile accident. He had been in charge at Wright Creek for about six months.

Automatic Caging Devices Prove Efficient at Horne Copper Mine

N. L. HARMON
The Mining Safety Device Company

CONSIDERABLE interest has been displayed in the modern car handling and control methods introduced by the Horne Copper Corporation at its mine at Noranda, Que. Special attention has been given to this feature in the last two years, with a view to increasing production at lower costs. The first caging equipment was tried out at the mine two years ago, and the company, pleased with the results, has since purchased 40 additional machines from the same manufacturer.

The present operating shaft is equipped with Nolan semi-automatic cagers, built by the Mining Safety Device Company, of Bowerston, Ohio, both on the surface and at seven different levels underground. On the cages are Nolan automatic stopping and locking devices, which catch and lock the cars in position for hoisting.



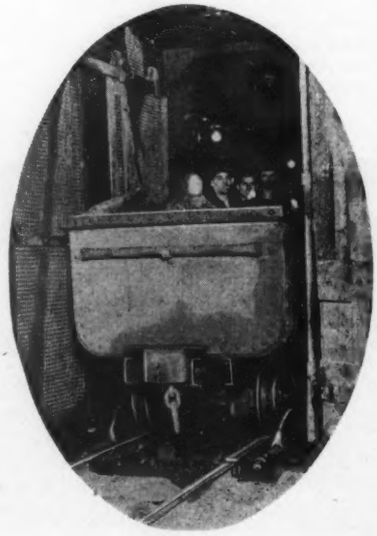
Car feeder used by Horne Copper Corporation at collar of present main operating shaft. By pulling a lever the operator opens the "horns" of the device, allowing one car to pass on cage.

The track arrangement at surface permits the spotting of 30 cars on the two tracks in front of the hoisting compartments. When empties are brought onto the tracks, they are caught and held by the horns of the cager. Tracks are on a 1½ per cent grade toward the shaft, so that, as the empty cars are fed onto the cage by the cagers, the other cars move by gravity to the shaft.

Arrangements on the seven different levels below ground are similar to those on the surface, except the grade, which is somewhat less, approximately 1¼ per cent.

When the cage, with a loaded car, reaches the surface, the cage tender throws in the chairs. As the cage is lowered onto these, the horns in front of the wheels automatically open, leaving the car free to run off the cage, when struck by the empty car which has been released from the feeder by the cage tender. As the front wheels of the entering empty car strike the cams, which serve as blocks to the rear wheels, the cams are deflected from their position across the rails, and this movement closes the horns in front of the entering car, which is thus automatically blocked on the cage. The loaded car runs down a 4 per cent grade to the kickback, then back around the outside of the shaft, where with others it is made up into a train of seven cars and hauled to the crushing plant.

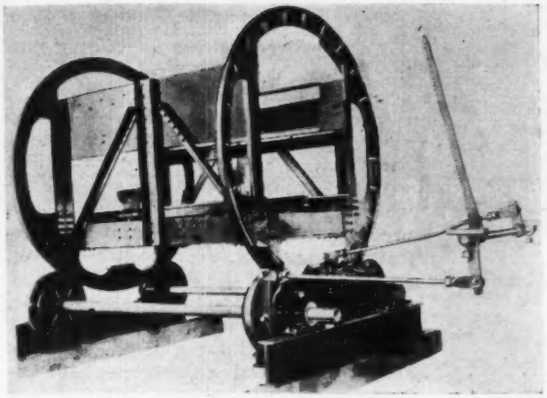
Automatic horn-stops on cage, which catch and hold car. The horns are shown in the open position.



The operation of loading the cars in the stations of underground levels is practically the same as that on the surface, except that when the cars come from the kickback they are hauled up an inclined track a distance of about 30 ft. by means of an endless chain. From the top of this 4-ft. lift, they run down a ½ per cent grade 100 ft. to the storage track in front of the shaft compartment. By this method, 30 full cars can be loaded and 30 empty cars returned on any one level, without locomotive switching and without manual handling.

This system of caging cars, although somewhat unusual in the larger metal mines, has been found satisfactory at the Horne mine, and the second operating shaft, which will be put into production in a few weeks, is being equipped in the same manner. At this shaft, however, the cars, instead of being trammed to the crushing plant, will be dumped into a storage pocket about 40 ft. from the shaft. Dumping will be done by two single-car Nolan power rotary dumpers, are supplied by the Mining Safety Device Company. Cars will be automatically fed to the dump by a Nolan feeder. After being dumped they will run down grade to a kickback and then to an endless chain, similar in type to those used underground. This chain will elevate the empty car through a vertical height of 5 ft., from which point it will run by gravity to the car feeder at the top of the shaft.

Ore dumped from the cars will drop into a 4,000-ton bin, excavated in the rock, from the bottom of which it will be fed through a gate to a jaw crusher, located 120 ft. below the surface, by a



Power rotary dump to be installed at Horne mine. The view does not show speed reducer, motor or couplings. Cars will be fed automatically to this dumper, as to the cage.

conveyor belt running to surface at an angle of approximately 16 deg. On surface it will be delivered to the secondary crushing plant.

The present depth of the second operating shaft is about 1,000 ft. The cagers are being installed to load cars at five different levels—namely, 100, 300, 500, 750, and 1,000 ft. below the surface. Underground loading arrangements will be practically the same as those now in use at the No. 3 shaft.

To cage cars at this mine averages five seconds' time. The weight of the loaded car is approximately 5,500 lb. Hoisting is done with a double-geared hoist driven by a 450-hp. induction motor, the hoisting speed being 1,500 ft. per minute. Acceleration is at the rate of 2 ft. per second.

H. L. Roscoe is assistant manager at Noranda, and to him I am indebted for the photographs and much of the information contained in this article.

Compressorless Diesel Engine Offers Opportunity for Economy With Reliability

ECONOMY of operation and fuel consumption is one advantage, if not the principal advantage, of Diesel engines. In the compressorless engine of this type, illustrated in the accompanying drawing, extreme economy, with reliability, is said to be obtained. This engine, made by Crossley Bros., Ltd., Manchester, England, is totally inclosed and self-lubricated. Easy access is afforded to the crank shaft and connecting rod bearings by means of large inspection doors on both sides of the engine frame. At the top are provided large cover plates, semi-hinged so that they can be opened immediately by hand or detached without unfastening a single bolt. When these are raised, the fuel sprayers, valve levers, camshaft, and operating gear are exposed to view. The engine can be operated with these top cover plates closed or removed.

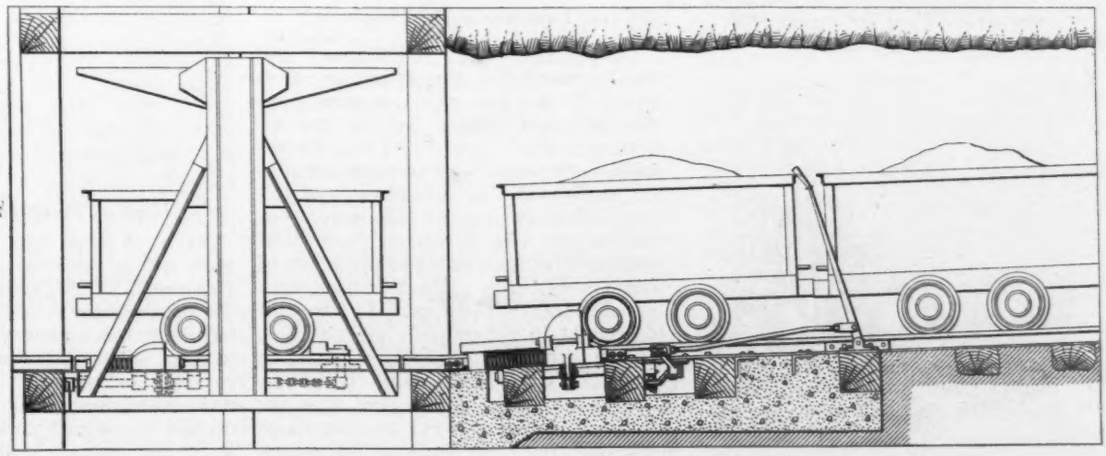
Starting—Instantaneous starting from dead cold with certainty is a feature which many will appreciate. Starting is effected by compressed air alone, without the aid of hot bulbs, electric plugs, or other auxiliary attachment. Air starter valves, fitted one to a cylinder, are automatically controlled from cams which come into action immediately the starting lever is moved into its starting position and the compressed air turned on. Acceleration at starting is quick, so that the time required to bring the engine from rest to full speed is a matter of seconds.

Fuel Oil Spraying—The Crossley patented system of precision spraying is employed. The amount of fuel oil injected into the engine is positively and accurately measured according to the load. This is effected by the governor, which varies the moment when each fuel pump control is opened and following the injection of the fuel oil. The actual governing takes place at the precise moment when the injected fuel oil is being burned, so that the governing is extremely sensitive and accurate under all working load conditions.

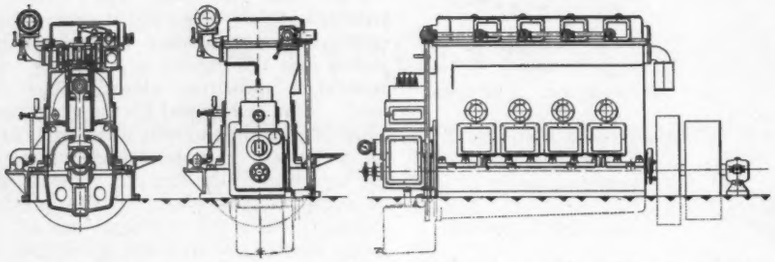
Overhead Valves and Gear—Inlet and exhaust valves are placed in the head of each cylinder, being operated directly from levers without push rods. This is possible because of the mounting of the camshaft on one side at the top of the engine. Steel cams fitted on the camshaft actuate the valve levers direct. The shaft is carried in suitable journals and is supplied with forced lubrication from the pressure system provided. These features of design insure silent working valve gear and freedom from rattle caused by reciprocating parts. The overhead camshaft is driven by a silent roller chain, entirely inclosed and continuously lubricated.

Forced Lubrication—The main bearings are continuously lubricated under pressure; also auxiliary moving parts such as camshaft, cams, valve levers, and governor. Such copious lubrication insures against breakdown or neglect by the attendant and adds to the life of the moving parts. It is made possible only by the total inclosure of these parts, the oil being used over and over again, without contamination by dust or dirt. A simple plunger pump maintains the oil pressure, delivering the oil from a sump in the engine base to the oil pipe system after filtration. After passing through the bearings, the oil drains back to the sump on the dry crankcase system.

Engine Frame and Baseplate—Engine frame or housing is designed on the box girder principle, representing the strongest form for a given weight of material. This construction permits the cylinders to be supported throughout their length, thereby avoiding torsional strains, which otherwise are set up from



Sketch showing semi-automatic arrangement for feeding cars to cage, installed at Noranda. On the cage is seen the stopping and locking device.



Sectional and end views and elevation of compressorless Diesel engine

side-sway when each cylinder is individually projected. The baseplate is massive and well ribbed inside to give the desired rigidity and maintains the crankshaft in alignment.

The crankshaft is made of the highest quality forged steel and is of unusually large proportions. Adjustable bearings for the journals and the connecting rod ends are liberal in dimensions to insure cool working and long life. An individual fuel pump is provided for each cylinder, but all pumps are grouped together in one unit as shown at one end of the engine.

Governing is effected by a centrifugal spring-loaded governor mounted directly on the crankshaft. Hand regulating or speeder gear is provided for varying the speed of the engine within limits and for synchonizing purposes if alternators be driven in parallel. The engine speed variation is controlled within 2 per cent above or below the mean speed.

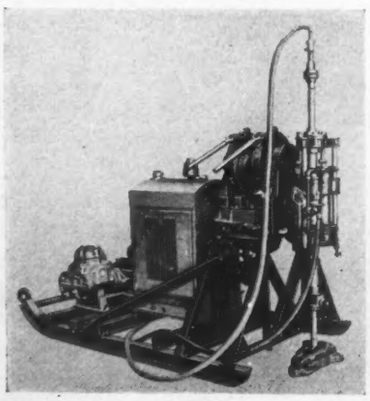
Other Equipment

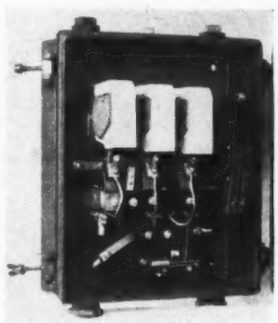
Equipment recently introduced for application in the mining and metallurgical fields includes several new and interesting devices. Among them are some new diamond drills for prospecting work and a hydraulic operating device for use wherever it is desired to provide a quiet and smooth upward thrust through a given distance.

The core drills mentioned have been produced by the Sullivan Machinery Company, Chicago. One, known as the "Type 20," a gasoline-engine-driven rig, is an entirely new machine developed for prospecting where the depth does not exceed 1,000 to 1,200 ft. Its capacity is 1,000 ft. when equipped with $1\frac{1}{8}$-in. core fittings, or 1,150 ft. with $\frac{1}{16}$-in. fittings. It may be had either with the hydraulic swivel head or the screw-feed swivel head and will drill at any desired angle. It is entirely self-contained and mounted on a steel skid, together with its pump and drive. The machine is provided with a hoist of entirely new design.

The other of these machines is the Type 40 drill, which is mounted complete with its gasoline-engine power plant, pump and hoist on a steel frame carried on a heavy steel wheel truck for convenience in moving. This has a capacity of 1,200 ft. with fittings that make a 3-in. hole, and takes a 2-in. core. Its capacity is 2,200 ft., with $1\frac{1}{8}$-in. core fittings. Although developed primarily for structure drilling in the oil field, this drill is nevertheless suitable for mineral prospecting under difficult conditions. The engine is a Buda 29 hp., 4-cylinder, 4-cycle unit.

A gasoline-engine-driven diamond core drill (Type 20) for depths up to 1,200 ft.





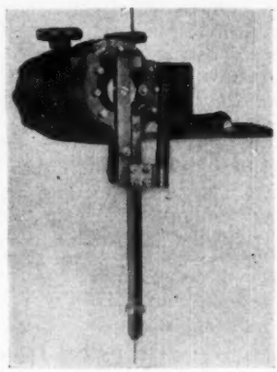
This line-starter is dust-tight

Line-Starter Dust-Tight

Development of dust-tight and weather-proof line-starters in three sizes up to 50 hp. has been announced by Westinghouse. These are of the remote-controlled, non-reversing, across-the-line magnetic type and are intended for single-phase and polyphase squirrel-cage induction motors. To insure continuous and efficient operation, several features have been added to the standard line. A cast-iron cabinet is used with a gasket seal on the door. The conduit is brought in through the top and bottom in threaded openings, to make a dust-tight connection. This starter is equipped with the Deion grid type arc quencher, which protects against flashovers and increases the life of contacts.

An Automatic Welder

An improved automatic welding outfit, known as the "Weldomatic," has been introduced by Westinghouse. It is provided with electrode feeding device, control cabinet, and operator's panel. It is designed to operate from variable voltage or constant-voltage welding motor-generator sets. Upon pressing the starting button, it automatically strikes and holds an arc between an electrode and the work to be welded. Compactness of design is obtained by a new method of automatic arc control. Features claimed for the new machine are: Positive feed without slippage; extreme sensitivity, insuring instantaneous response to arc voltage conditions; wide range of speeds; compact mounting dimensions, combined with light weight; simplicity of design; ease of adjustment, and smoothness of operation.



An improved automatic welding machine

A new alloy furnished in the form of welding rods for applying a highly wear resistant surface by either the oxy-acetylene or metallic arc welding processes has been introduced by Fusion Welding Corporation, Chicago. This is known as Type-T metal. Not only is it as hard as, or harder than, other alloys, but it also possesses ductility which gives to it very unusual properties.

A New Chain Hoist

Features of a differential chain hoist announced by Robbins & Myers, Inc., Springfield, Ohio, are: Timken thrust bearings are used in the lower hook, thus permitting easy turning of the load and reducing the wear of the chain and upper sheave wheel caused by twisting of the chain. The sheaves are of a durable iron alloy. The hoist is made in five sizes, ranging from $\frac{1}{4}$-ton to 2 tons' capacity.

Largest High-pressure Boilers

Early in 1930 two steam-generating units will be constructed by Combustion Engineering Corporation at the Ford Motor Company's Fordson plant, which will have the highest steaming capacity of any boilers ever built for pressures as high as 1,350 lb., for which these units will be designed. Each will have a maximum capacity of 700,000 lb. of steam per hour. Steam will be super-

heated to a total temperature of 750 deg. F. Pulverized coal will be used for firing, entering the furnaces tangentially at the corners to give a turbulent mixing action of fuel and air. The furnaces will be of the all-metal, water-cooled type. Air preheaters will be used in connection with them to utilize the heat of the exit gases.

Welding Machine Drive Improved

A new portable electric arc welding machine driven by a six-cylinder gas engine has been introduced by General Electric to replace the four-cylinder engine-driven unit previously included in its line. The six-cylinder engine affords ease of starting, steadiness of operation, and greater capacity. The generator is designated WD-300-A. The engine is the Buda Model HS-6 unit, totally inclosed, and actually develops 39 b.hp. at 1,440 r.p.m. Gasoline consumption averages 2.4 gal. per hour for average welding duty. The welding generator itself is a ball-bearing, self-excited, single-operator machine rated 300 amp., 1 hour, 50 deg. C., with a current range of 90 to 375 amp.

A Universal Limit Switch

General Electric has also announced a new cam-operated limit switch for industrial control applications which supersedes the various older types made by the company and combines all their advantages in one device. The switch is designated as LS-438, and is inclosed in a cast case. It is a two-circuit model which by a simple adjustment can be made either normally open or normally closed, or one circuit open and one closed.

Conveyor Carrier Improved

Improvements of its Sacon Carrier for heavy-duty belt conveyors has been announced by Stephens-Adamson Manufacturing Company, Aurora, Ill. The new features are double Timken roller bearings for each self-aligning bearing, belt rollers with end castings to prevent collection of material and moisture, and a new hood-type end bracket to protect the outer bearings.

A new and strongly built paving breaker

For Breaking Concrete

A new light pavement breaker for a wide range of service has been introduced by the Gardner-Denver Company, Denver, Colo. This model, which is known as No. 4-15, weighs only 48½ lb. Air consumption is said to be low and the design sturdy.

INDUSTRIAL NOTES

Union Carbide & Carbon Corporation announces that Matthew J. Carney, vice-president, has been elected a director of the corporation.

The American LaFrance & Foamite Corporation, manufacturers of fire-fighting equipment, announces the removal of its branch from Utica, N. Y., to Elmira, N. Y.

The George D. Whitcomb Company, of Rochelle, Ill., has a new factory unit under construction. This plant will be used primarily for the manufacture of large oil-electric locomotives.

The Dodge Manufacturing Corporation, of Mishawaka, Ind., announces the appointment of E. S. Grant, formerly asistant general sales manager in charge of the eastern district, as general sales manager.

The Chain Belt Company, of Milwaukee, Wis., announces the removal of its office at Houston, Tex., from 1000 Marine Bank Building to 1310 Second National Bank Building. Mr. Russell G. Davis is manager.

The Lincoln Electric Company, of Cleveland, has placed contracts for the erection of an addition to its present plant. The Austin Company, of Cleveland, is erecting the building, which is to be of arc-welded steel construction.

The Gardner-Denver Company, of Denver, Colo., announces the recent departure for their posts of two foreign branch managers. Ralph Scott, formerly sales manager of the drill division of the company, is en route to London, where he is to be stationed permanently. W. G. Agnew, who was sales representative in Arizona, has left for Lima, Peru, to take charge of the office there.

Hercules Powder Company has recently announced plans for the erection of an experimental station near Wilmington, Del. The present experimental and research laboratories at Kenvil, N. J., will be moved to the new site.

Wagner Electric Corporation, of St. Louis, announces the opening of a new branch sales office in Dallas, Tex. A. B. Emrick has been transferred from the Pittsburgh branch office to be manager of the new office.

E. I. du Pont de Nemours & Company announce the appointment of John W. McCoy to the position of general manager of the explosives department. J. T. Brown, formerly general manager, has been elected a member of the executive committee of the company.

Worthington Pump & Machinery Corporation announces the appointment of E. J. Schwanhausser to the position of manager of the Buffalo office. Mr. Schwanhausser has been assistant manager of the Harrison plant of the company for the last two years.

Ingersoll-Rand Company of California, a subsidiary of Ingersoll-Rand, has moved its offices from the Rialto Building, San Francisco, to a new building at 350 Brannan St., which it occupies exclusively.

BULLETINS

MOTORS—Elliott Company, Jeannette, Pa. Bulletin No. L-3, describing Type A-1 synchronous motors for compressor drive.

FLOTATION—The Ruth Company, Denver, Colo. Booklet on development of gradient flotation.

SHOP EQUIPMENT—The Oesterlein Machine Company, 3301 Colerain Ave., Cincinnati, Ohio. New Aurora drill catalog.

WELDING — General Electric Company, Schenectady, N. Y. Bulletin No. GEA-571C. Arc-welding accessories.

WELDING—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-875D. Type WD 300A arc welder.

WELDING—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-874D. Type WD 200A arc welder.

COUPLINGS—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Circular No. 1838, Type E flexible couplings. Eight pages.

FITTINGS FOR PIPE STRUCTURES—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Circular No. 1676-B.

BOILER FEED CONTROL—Northern Equipment Company, Erie, Pa. Catalog on modern feed water regulation with the Copes system of boiler feed control.

FIREBRICK — The Denver Fire Clay Company, Denver, Colo. Catalog 141-T on firebrick, firebrick shapes, mouldable furnace lining and high temperature cements; also new bulletin 142-T, describing DFC flat suspended arches, monolithic furnace wall construction and suspended arches for horizontal return tubular boilers.

STEEL PANELS—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Bulletin A.I.A. File No. 31d26, "Revolutionize Switchboard Design."

CENTRIFUGAL PUMPS — Byron Jackson Company, Berkeley, Cal. Bulletin 295. Type "S" double-suction single-stage horizontally split case.

V-BELT TRANSMISSION — Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Leaflet No. 20,392 entitled "Cog Belt Drives for Industrial Service."

MOTORS — General Electric Company, Schenectady, N. Y. Bulletin No. GEA-724B. Totally inclosed, fan-cooled squirrel-cage motors, "900 Series" frames.

COMPRESSOR — General Electric Company, Schenectady, N. Y. Bulletin GEA-1121. Reciprocating air-compressor sets, single-stage, portable.

CONCRETE WATERPROOF—Silica Products Company, 700 Baltimore Ave., Kansas City, Mo. Bulletin No. 103, describing "Aquagel" plasticizing, waterproofing and strengthening agent for cement, mortar, and concrete.

MOTOR GENERATOR — General Electric Company, Schenectady, N. Y. Bulletin No. GEA-394A. Induction motor-generator sets, ½ to 35 kw., 125 to 250 volts.

CHAINS—Chain Belt Company, Milwaukee, Wis. New general catalog No. 330. Contains over 800 pages of information pertaining to the products of this company and the Stearns Conveyor Company.

NEWS OF THE WEEK

Summary

HECLA MINING'S new 2,100-hp. hoist will raise 2,000 tons of ore daily, to be obtained equally from the Hecla and Star mines, in the Coeur d'Alene district of Idaho. Operation will probably be started about Nov. 15. Page 674.

* * *

Evans-Wallower Lead is now operating its new electrolytic zinc plant at East St. Louis, Ill., at capacity. A lead plant to recover lead from the residues will be started in December. Page 677.

* * *

Diamond drilling from the 3,625 level of Kirkland Lake Gold, in the Kirkland Lake district of Ontario, has struck ore about 200 ft. below that point. The grade of this material is said to be high. Page 678.

* * *

New deposits have been discovered by the companies opening up lead-zinc orebodies near Great Slave Lake, Northwest Territory, Canada. A large tonnage is already assured. Page 676.

* * *

N'Changa Copper has reached the 600 level in shaft-sinking operations at its property in the N'Dola district of Northern Rhodesia. Five new diamond drills are now in operation. Page 676.

* * *

Peru Mining has completed making changes at its flotation plant, near Deming, N. M., and is now operating on a basis of 300 tons daily. Page 676.

* * *

Northern Peru Mining & Smelting has installed a Cottrell plant at its Shorey smelter, Trujillo, Peru, and is now installing a Dwight & Lloyd sintering machine. Page 678.

* * *

The railroad spur to Falconbridge Nickel, near Sudbury, Ontario, has been completed, the smelter buildings are inclosed, and production is expected to start in January. Page 673.

A. D. Storke Believes Major Problems in Northern Rhodesia Can Be Surmounted

Director of Roan Antelope States That Labor Difficulties Have Been Considered and Emergencies Anticipated—Optimistic on Stable Copper Prices and Low Working Costs

OWEN D. LETCHER
Special Johannesburg Correspondent

THE future of the Rhodesian copper mines, now being developed in the region near N'Dola, is viewed without apprehension by A. D. Storke, director of Roan Antelope Copper and Rhodesian Selection Trust, who recently granted me an interview in London. Mr. Storke is an American mining man. In Africa he has been prominently associated with the reopening of the Namaqualand deposits as well as the Northern Rhodesian mines. He has a thorough grasp of the world situation and outlook for copper. He believes that copper prices will be maintained at about their present level, even though Northern Rhodesia may be producing as much as 750,000 tons of copper annually within ten years.

Mr. Storke's views on labor are of particular interest, since this problem is considered by many to be the most important that must be overcome in developing Rhodesia.

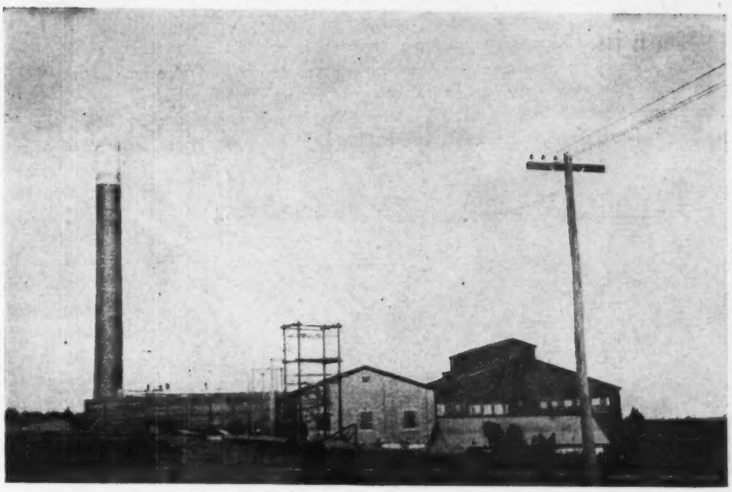
"I think that by effective organization and good treatment we shall obtain the native labor we require," he said. "But we are modeling our mines and plants on the assumption that periodical shortages of native labor will occur, as in all countries where the bulk of the labor force consists of colored aboriginals. We are accordingly installing both underground and surface labor-saving appliances wherever the employment of such devices is economically practicable. In the Roan Antelope we have already installed mechanical slushers for handling the ore. The natives are adapting themselves well to the use of these appliances. In considering efficiency, on account of the size of the orebodies—which are relatively huge by comparison with, say, those of the Rand—tonnage per 'boy' will be very high in spite of the fact that the comparative efficiency of a Northern Rhodesian mine 'boy' is likely to be actually less than that of a Rand mine native.

"Another very important consideration is health. This is a matter which vitally affects the efficiency and contentment of all employees, white and colored. We are leaving no stone unturned to put matters in regard to health and hygiene on as satisfactory a basis as possible. We are spending very large sums of money on housing for our white employees. You have seen for yourself the type of dwelling house that is being built at the Roan Antelope mine, and you will, I think, agree that in these habitations no expense is being spared to render our employees and their dependents comfortable and contented. A huge expenditure in connection with housing has had to be faced, but it is money well spent. Then, too, we are shortly dispatching to Northern Rhodesia a medical mission at the head of which is Sir William Simpson, the eminent British authority on tropical disease and hygiene. In the course of time we hope to overcome entirely the malaria menace."

"What about the economic aspects, questions concerning working costs and profits, and when profits will be earned, Mr. Storke?"

"Well," he replied with a smile, "I suppose you have seen the flood of figures, statistics, and estimates appearing in the press. I won't say too much about it, except to remark that while I thoroughly approve of caution, I believe some of the statements and calculations that have recently appeared have been too conservative. Several papers have assumed a cost of production when operating on a large scale in Northern Rhodesia that, to me, appears altogether too high. In one quarter it has been suggested that 78 per cent of our cost of production will be labor, and since it has been argued that labor will be our principal trouble, working costs have been rated up against us. This estimate of labor costs is far too high. Stores and supplies will constitute a bigger item than labor charges.

"As to date of production, we may be able to get the Roan plant into running commission by the end of 1931 or early in 1932. We are doing everything possible to reach production at the earliest date. The power plant at the Roan is virtually completed and sinking in the main shaft is going ahead satisfactorily. Good progress is being made



The Falconbridge smelter and power plant

with details of the concentrator. Smelting tests are now being carried out under Mr. MacGregor's supervision in America. The smelter will be the last unit to be designed and installed. If we get going by the end of 1931 it will be almost a record performance, considering transportation, size of plant, and other factors.

"Of course," remarked Mr. Storke in conclusion, "we have had a lot of difficulties to contend with in Northern Rhodesia. Other big copper enterprises in outlying territories have also had difficulties and plenty of critics. Take Chile Copper for example. The critics said labor would be an insurmountable difficulty in Chile, and they argued there would be all sorts of other handicaps that could not be overcome. But they have been surmounted. We shall conquer our difficulties in Northern Rhodesia as well. I have no apprehensions in regard to the future of Northern Rhodesian copper."

Coppermines-Nevada Case Starts at Carson City

IN THE Federal Court at Carson City, Nev., the suit brought by Nevada Consolidated Copper to secure an injunction against Consolidated Coppermines was started on Oct. 21, 1929. Nevada is attempting to compel Coppermines to alter its present plans for underground mining of certain orebodies, belonging to Nevada, in the Ely district.

The controversy is of more than ordinary interest. No apex rights are involved, but orebodies contiguous to the boundary line separating the properties of both companies form the basis of contention. How and when they are to be mined is the question. Coppermines, in furtherance of its interpretation of an existing agreement between the two companies, signed June 16, 1926, has started an underground mining program for the mining of certain of Nevada's ores. Nevada contends that such a program, if carried out, will cave and destroy the western end of Liberty Pit, interfere seriously with its entire pit operations, and endanger its Wedge shaft, as well as causing great damage to the properties. Nevada also contends that the Coppermines program is not in accordance with the agreement of 1926.

Coppermines contends that its mining program is in strict accordance with the contract of June 16, 1926. It contends that Nevada did not object to this mining program until recently, when failure of Nevada's shaft was feared. According to Coppermines this was the result of Nevada's own mining operations, influencing Nevada to plan for extending steam-shovel operations, thereby delaying underground operations. Coppermines further contends that Nevada has no reason to delay the underground operations, and that as Coppermines has expended large amounts in preparation for mining, according to the original program, the changes that Nevada recently insisted upon are not justifiable and not practicable.

Efforts of the officials of both corporations to reach an amicable settlement have proved futile, and Nevada started court proceedings on March 26, 1929. When the parties were before the court on Nevada's application for a preliminary injunction, a stipulation was entered into governing operations pending the outcome of the suit.

To Start Building Frood Concentrator Soon

Work will soon be started on the construction of the new concentrator of International Nickel at Copper Cliff, in the Sudbury district of Ontario. Original plans provided for a plant with a capacity of 4,000 tons of Frood ore daily, but this has recently been revised to 8,000 tons daily. Official details of the methods to be used in the plant are lacking, but flotation equipment is said to be included in the plans. Magnetic separation is used at the other mines of the company. Dominion Bridge has been awarded the contract for the plant, which will be more than 900 ft. long.

Falconbridge Railroad Spur Now in Operation

WITH the completion of the new railroad extension of the Canadian National Railways to the Falconbridge mine, in the Sudbury district of Ontario, bringing this property into production will be considerably hastened. The smelter will probably be blown in some time in January, 1930. The smelter building is completely inclosed, both converters are installed ready for bricking, and the greater part of the furnace equipment is on the ground.

At the mine underground work is progressing on the 225 and 1,000 levels. Raises have been driven in ore, preparatory to stoping, at the former level. At 1,000 ft., about 1,500 ft. of lateral work has been completed. Crosscutting has been started to establish diamond-drill stations for the deep-drilling campaign which will be initiated this autumn.

Coincident with the arrival of the first trains at the Falconbridge, a start was made on excavation for a mine hospital and a schoolhouse. When completed, the latter will open with an enrollment of about 40 pupils.

Montana Mines Increasing Mill Capacity to 400 Tons

Additional machinery has been ordered by Montana Mines to bring the capacity of its Spring Hill mill, in Montana, up to 400 tons a day. During September, an average of about 150 tons daily was treated at the mill, which was recently changed to a flotation plant. Mill heads averaged $7.35 a ton and mining and milling costs were $3.40 a ton. Diamond-drilling and lateral work has showed a large orebody, assaying from $6 to $21 a ton.

Basin Montana Strike Increases Interest in Camp

ACTIVITY in the Basin district of Montana has been increased by the strike recently made in the south Comet vein of Basin Montana Tunnel. The ore has been opened for 100 ft., and is largely of shipping grade. This development is in the company's Grey Eagle mine. On the 500 level of that property, copper and silver ore in the drift west of the winze is showing increases in grade.

At the Bullion property in the district, taken over recently by Milwaukee interests, several trucks are hauling ore to the railroad, returning with lumber and machinery for the camp buildings and a 100-ton flotation plant that will be built.

M. D. Kelly and associates, of Milwaukee, recently acquired the Silver Hill group, which has a production record of $200,000. This group is between the Comet mine and the Grey Eagle mine. A company known as Silver Hill Mines, Inc., has been formed to operate the property.

Renewed Activity Shown in Leadville District

ACTIVITY in the Leadville district of Colorado is now more pronounced than it has been for several years. American Smelting & Refining is producing about 10,000 tons of ore a month from its Leadville Deep mines, and Colorado Zinc-Lead is handling about 300 tons daily at its flotation plant. Only one furnace is in operation at the Arkansas Valley smelter of A.S.&R. at present, but a possibility exists that a second furnace will be put in operation when the new Empire Zinc mill, at Belden, is started. About 350 tons of ore and concentrate can be handled in the one furnace.

Penrose Mines now has 23 patented claims under control in the district as part of its program of reopening and unwatering the mines in the downtown part of the district. These claims extend north to Carbonate Hill, east to the Midas, and west to the Big Chief.

United Gold Exploring Last Effort Mine

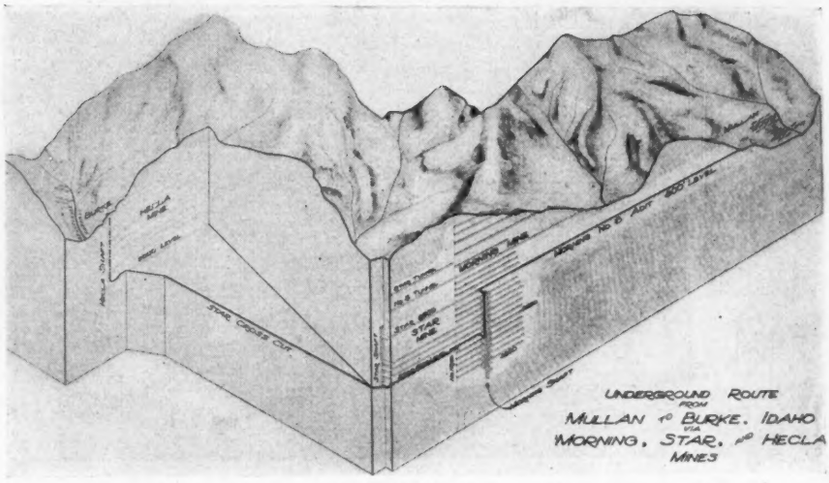
United Gold Mines started drifting in the Last Effort mine, in the Cripple Creek district of Colorado, early in October. Operations are being carried on through the Elkton shaft and the Roosevelt drainage tunnel. A drift will explore ground 300 ft. beneath an ore-shoot that was mined by Portland Gold, when that company operated the property. The drift is within 75 ft. of the point at which the company expects to encounter this orebody, according to the most recent reports.

Stokes Estate Forecloses on Nevada Mining Claims

On Oct. 14, three parcels of mining property were sold at a sheriff's sale in Nye County, Nev., to satisfy a mortgage of $100,000 held by the Stokes estate, of New York. The Nevada Company, which is controlled by the Stokes interests, bought the properties for $30,000. The properties included in the sale were Goldfield Blue Bell Mining, at Goldfield, including a 30-stamp mill and power plant; 16 patented claims in the Union district, near Downeyville, Nev.; and 8 claims in the Golden Arrow district, Nye County.

United Mercury Buys Helen, Near Middletown, Calif.

United Mercury, of New York, is reported to have purchased the Helen mine, 6 miles west of Middletown, Lake County, Calif., from H. W. Gould & Company, of San Francisco. The property is equipped with a 3x40-ft. rotary furnace. Last year it was operated under lease by Peterson and Vanderbeck, of Middletown. It has been worked to a depth of about 180 ft.



How three of the Coeur d'Alene district's most important mines are connected underground

Hecla's New 2,100-Hp. Hoist Will Handle 2,000 Tons of Ore in Nine Hours

To Go Into Operation on Nov. 15, Hoisting Material From Star and Hecla Mines—Can Work to a Maximum Depth of 5,000 Ft. at a Speed of 2,400 Ft. per Minute

INSTALLATION of the new main hoist, designed to handle 2,000 tons daily, at the main shaft of Hecla Mining, in the Coeur d'Alene district of Idaho, is nearing completion. Operations are expected to begin Nov. 15. A new materials hoist has also been installed and recently went into service. Both hoists were made by the Nordberg Manufacturing Company. Electrical equipment was supplied by Allis-Chalmers. John Nancarrow, engineer with the Nordberg company, is supervising the installation. A. C. Stevenson, chief electrical engineer, and J. B. Sloan, master mechanic, of the Hecla company, prepared the specifications for the hoists and electrical equipment, as well as the plans of the hoist building.

The new main hoist can lift seven tons at a speed of 2,400 ft. per minute from a depth of 3,500 ft. The lowest level of the Hecla shaft is now 2,800 ft., but it will be deepened to 3,200 ft. after the new hoist is in service. In fact, the hoist will be able to operate to 5,000 ft. by reducing the load.

A total of 2,000 tons of ore will be lifted daily by the hoist in a working period of nine hours. This will come equally from the Star and Hecla mines. Star ore is predominantly zinc in content and is shipped to the Sullivan electrolytic zinc plant after concentration. The mine, which was reopened last winter, has been producing about 450 tons daily. The accompanying sketch shows a cross-section of the Hecla, Star, and Morning mines, including the Star crosscut along which ore is hauled to the Hecla shaft. Copies of this sketch were distributed at the recent Spokane meeting of the American Mining Congress and the A.I.M.E., when about 100 engineers made a trip underground from the mouth of the Morning adit, at Mullan, to the collar of the Hecla shaft, at Burke, a distance of 5 miles. The route of the trip is indicated by the heavy line in the sketch. The maximum depth reached by the party was 4,600 ft.; this occurred beneath the summit of the divide between Mullan and Burke.

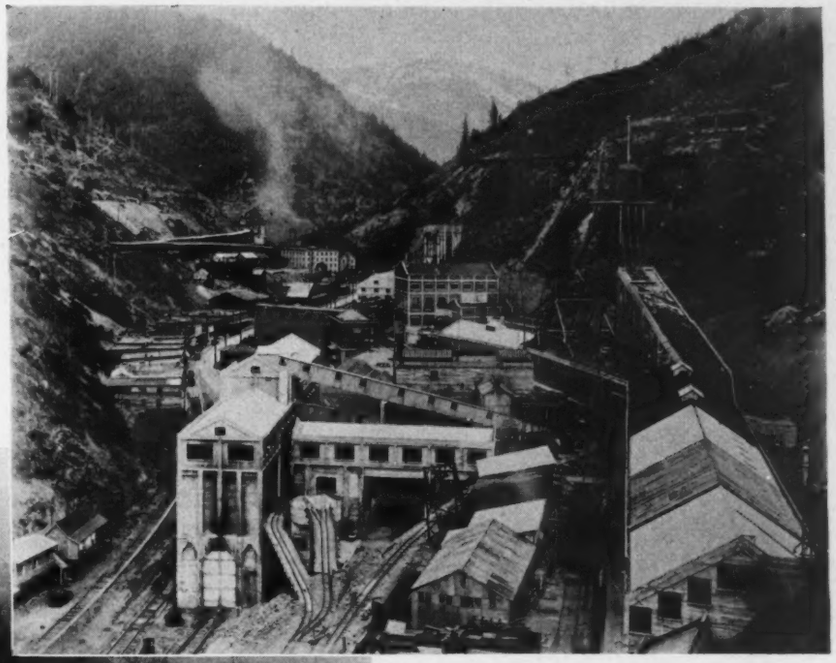
The new main hoist will have two drums, each 10 ft. in diameter with 6-ft. faces, grooved for winding 3,585 ft. of 1¾-in. rope. It will be driven by a motor with a continuous capacity of 2,100 hp. and peak capacity of 3,750 hp. The motor-generator set will consist of a 2,300-volt, three-phase synchronous motor with a capacity of 2,450 kva. at 78 per cent power factor, and a 1,700-kw. generator, supplying 500-volt direct current.

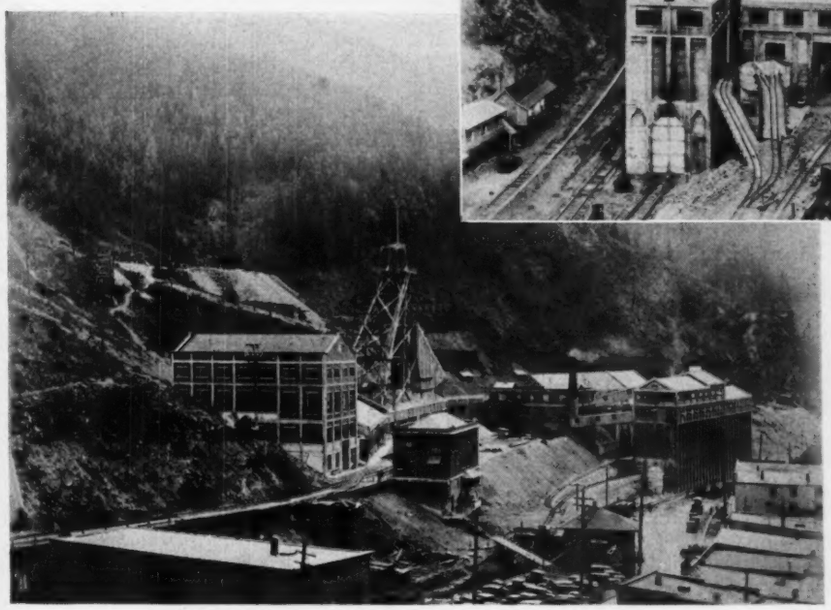
Nothing has been omitted in the way of safety devices. A Lilly safety control prevents over-winding and under-winding. Man speed on the hoist is held to 1,350 ft. per minute, using full control. All actions of controls are preceded by an alarm bell. Independent of the Lilly control, a mechanical device called "Cam safeties" is geared to the drum. It operates the master controller at the end of the winds, automatically slowing down and stopping the hoist if the operator fails to do so. Hatchway limit switches in the shaft stop the cage or skip from passing the point of attachment. An emergency stop switch is placed at the operator's platform and at the collar of the shaft. The hoist will

travel only in the direction opposite to that in which it was going at the time of the engagement of the safety in case of running into the over- or under-winding device. A confused operator or a failure in directional control thus cannot put the cage or skip further into the sheave or sump.

Whenever the hoist is handling a heavy overhauling load, power is being returned to the supply line. This prevents overspeeding. Overspeed protection is provided on the motor-generator sets, independent of Lilly control, to prevent an interruption of the supply circuit that would remove the effect of the returned power, with the resulting inclination of the hoist and motor-generator sets to run away.

The man-handling problem governed the size and equipment for the material hoist, which is a single-drum, 850-hp. unit. To speed handling, the same size three-deck cages will be used on this hoist as on the main one, with the same safeguards. The new hoist building is of reinforced concrete beam and column construction with tile panels. Appearance, warmth, and weight were all considered. All floors are designed to carry the weight of the heaviest unit part of the equipment that might be placed on them. Each hoist is in a room by itself and separate from the generator room, so that noise may not bother the operator or signals be confused.





Above—The Hecla surface plant, looking toward the town of Burke. New hoist building is behind the headframe.

At the left—The Hecla surface plant from another vantage point, with the new hoist building at the left, the headframe in the center, and the ore bins at the right.

Colorado-Mexico to Operate Iowa Mill at Silverton

Operation of the Iowa mill, in the Silverton district of Colorado, will revert to Colorado-Mexico Mining as soon as the new Shenandoah-Dives plant on Arastra Gulch is completed. The Shenandoah-Dives company has been using the mill, which belongs to Colorado-Mexico, for the last two years. About 100 tons of ore will be produced daily by the latter company.

Howell Ships Tarbaby Ore

Shipping ore is being stoped in the Tarbaby lease of Howell Mining, in Big Cottonwood Canyon, south of Salt Lake, Utah. The first shipment carried 126 oz. of silver to the ton, 4 per cent lead, and 5 per cent copper, netting the company $68 a ton after teaming, railroad, and smelting charges. Ore is being followed to the overthrust contact in one place. Drifting on the contact into the Howell property and drifting along the mineralized fissure to the southwest in the footwall limestone is also being carried forward.

Geophysics Discussed at Colorado School of Mines

A gathering of geologists at the Colorado School of Mines, Golden, Colo., on Oct. 14, discussed what geophysics means to the mining industry. James Fisher, of Michigan, reported that his state had appropriated $25,000 for research in the science. Dr. M. F. Coolbaugh, president of the School of Mines, stated that although much progress had been made in teaching the new science, laboratory equipment was inadequate.

California Men Reopening South Mountain Mines

ORGANIZATION of the Exploration Company of California has been undertaken by Charles Butters and T. J. Barbour, of San Francisco, to operate the historic South Mountain mines, Owyhee County, Idaho. Development, estimated to cost $250,000 over one and one-half years, is planned. If results are up to expectations, the property will be equipped at an additional cost of about $1,000,000 before starting production.

These mines were owned from 1870 to 1874 by the Bank of California, of San Francisco. Work ceased when the bank failed. Minerals Separation has made tests which indicate that material that was once junore because of metallurgical difficulties can be treated profitably by flotation.

Vigilante Completes Plant

Vigilante Mining, operating the old Buckeye mine, near Sheridan, Madison County, Mont., has completed construction of its flotation plant. Machinery for the installation was furnished by the Butte Machinery Company.

New Deposits Found in Great Slave Lake District

DURING the present season, important new outcrops of lead-zinc ores have been found in the Great Slave Lake district, Northwest Territory, Canada, a few miles from the original discoveries. The properties lie 32 miles southwest of Fort Resolution, on Great Slave Lake, and are reached by airplane or by boat from Fort McMurray, the present end of steel. They are controlled by Consolidated Mining & Smelting, Ventures, and Atlas Exploration.

Discoveries were first made in 1898 during the Klondike rush, when the route through Great Slave Lake and the Mackenzie River was followed by many anxious to reach the Yukon. At that time the country was staked far and wide, but when it was found that the ores did not carry precious metals the claims were allowed to lapse. In 1914 restaking was done on behalf of Huronian Belt, but with the outbreak of war these claims were also allowed to lapse. They were again staked in 1920 for a private syndicate, but practically no work was done on the properties until 1928. In the spring of 1929 Consolidated and Ventures became associated with the operating syndicate.

Men and supplies were transported by airplane, a prospecting plant was brought in by water, and active exploration started. The original work consisted of shallow test pits, but a shaft is now being sunk and drilling is being done. Early transportation difficulties have been largely eliminated. Supplies are now delivered to the property from Edmonton for 6½c. a pound, or about one-third of the former cost.

The orebodies occur as bedded deposits in a crystalline dolomite. Some outcrop and others are covered by a thickness of a few feet of rock. Several discoveries have been made, three of which are roughly circular and about 250 ft. in diameter. The dimensions of the largest are 900 ft. long by a maximum width of 200 ft. To date the smallest deposit found is 125 ft. by 80 ft. The ore consists of galena, sphalerite, and pyrite and carries very little silver. For a depth of 55 ft. in the prospecting shaft the following average assays were obtained:

Depth in Feet	Lead, Per Cent	Zinc, Per Cent
0—18	43.29	16.87
18—30	20.65	26.25
30—42	6.90	4.65
42—55	9.01	5.60

The small amount of work done to date has already indicated a large tonnage. If the orebodies open up according to present indications, a railroad may be built to this district. Power possibilities have been reported on by H. G. Acres, consulting hydro-electric engineer. The falls on the Hay River, which flows into the Great Slave Lake, are expected to provide an adequate supply of power. Transportation has been investigated by H. McLean, who built the Flin Flon and Sherritt-Gordon branch lines. Surveyors are already running trial lines into the district. If the railroad is built, it will be constructed jointly by the Canadian National Railway System and the Canadian Pacific Railway.

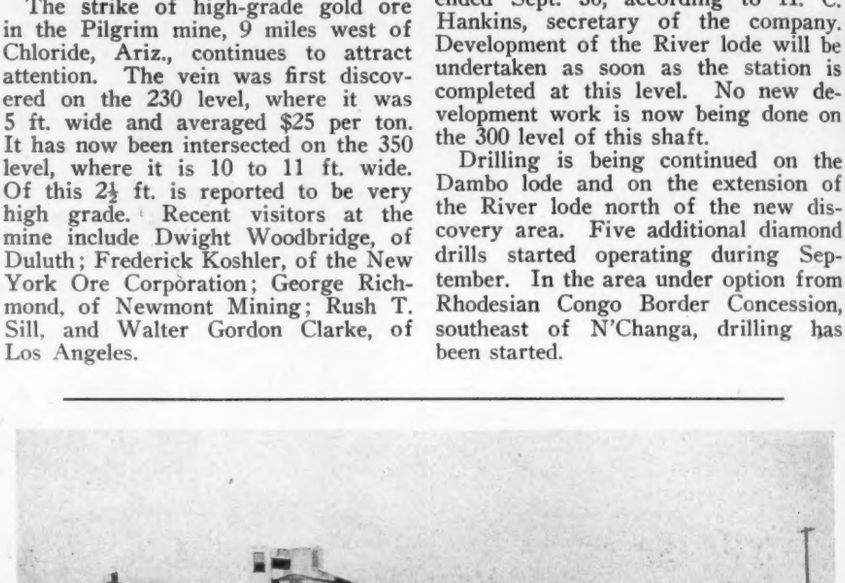
Pilgrim Cuts Ore at 350 Ft.

The strike of high-grade gold ore in the Pilgrim mine, 9 miles west of Chloride, Ariz., continues to attract attention. The vein was first discovered on the 230 level, where it was 5 ft. wide and averaged $25 per ton. It has now been intersected on the 350 level, where it is 10 to 11 ft. wide. Of this 2½ ft. is reported to be very high grade. Recent visitors at the mine include Dwight Woodbridge, of Duluth; Frederick Koshler, of the New York Ore Corporation; George Richmond, of Newmont Mining; Rush T. Sill, and Walter Gordon Clarke, of Los Angeles.

N'Changa Cutting Station at 600 Ft. in New Shaft

A STATION is now being cut at 600 ft. in the main vertical shaft of N'Changa Copper Mines, in Northern Rhodesia, The shaft was sunk from 421 ft. to 614 ft. during the quarter ended Sept. 30, according to H. C. Hankins, secretary of the company. Development of the River lode will be undertaken as soon as the station is completed at this level. No new development work is now being done on the 300 level of this shaft.

Drilling is being continued on the Dambo lode and on the extension of the River lode north of the new discovery area. Five additional diamond drills started operating during September. In the area under option from Rhodesian Congo Border Concession, southeast of N'Changa, drilling has been started.



The remodeled flotation mill of Peru Mining at Wemple, N. M.

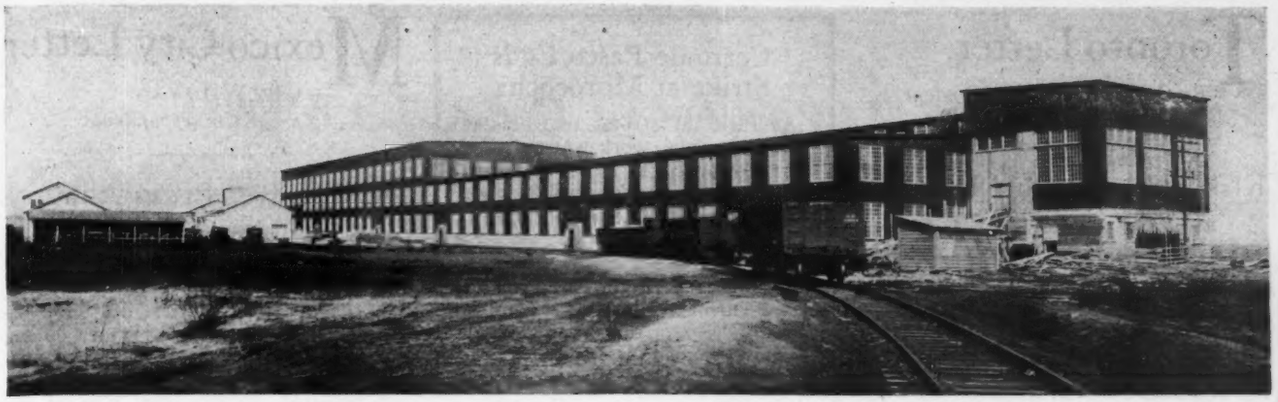
Peru Mining Steps Mill Capacity Up to 300 Tons

ADDITIONS to the custom flotation plant of Peru Mining, a subsidiary of Illinois Zinc, at Wemple, near Deming, N. M., were completed in the latter part of September, raising the capacity from 200 to 300 tons daily. The mill is now operating at capacity and shipping about 2,500 tons of concentrate monthly. It consists of two units, one for the treatment of zinc ore and the other for the treatment of complex zinc-lead-silver ore by selective flotation. Ratio of concentration is about 5 to 1 for the straight zinc ore and about 2½ to 1 for the complex ore.

Ore from the mines is unloaded from bottom-dump cars into hoppers which feed the crushers by belt conveyor. After being crushed in a Symons cone crusher to ½-in. size, the ore is stored in ore bins, which, in turn, feed 6x6-ft. Marcy ball mills by belt conveyor. After classification, the pulp goes to Minerals Separation flotation cells, operated in series as roughers and finishers. Zinc concentrate and middling are cleaned in Southwestern air-flotation cells. Concentrate is then delivered to Dorr thickeners and filters. Zinc concentrate averages from 50 to 53 per cent zinc and lead concentrate about 40 per cent lead, 15 per cent copper, and 25 oz. of silver to the ton.

Completing Edgemont Mill Near Tuscarora, Nev.

BUILDING of a twenty-stamp mill at the Edgemont mine, north of Tuscarora, Nev., is practically completed, according to H. H. Carpenter, general manager of Idaho-Nevada Mining, which operates the property. The mill is being built at the tunnel portal to eliminate transportation of ore to the old mill by cable tramway. Machinery from the old mill will be used in the new plant. Power is furnished by a hydro-electric plant, 2 miles north of the mill. The ore carries gold, silver and lead. If amalgamation and tailing treatment by cyanidation does not give the expected extraction, the plant will be changed to flotation.



New Evans-Wallower electrolytic zinc plant at East St. Louis, Ill.

New Evans-Wallower Plant Operating at Capacity

OPERATION of the new Evans-Wallower electrolytic zinc plant, at East St. Louis, Ill., was increased to the rated capacity of 50 tons of zinc daily on Oct. 15, according to an official announcement of the company. The melting furnace was placed in operation on the same day and slabs carrying the trade name "Evanwall" were cast for shipment. Carload lots were shipped last week to consumers. All zinc produced has a purity of more than 99.99 per cent.

Evans-Wallower Zinc, a subsidiary of Evans-Wallower Lead, is the operating company. The plant adjoins the Monsanto Chemical Works, and sulphur gas is delivered to that company for the manufacture of sulphuric acid. Ground for the new plant was broken on Oct. 1, 1928. The roasters were started early this September, and power was switched on the cell room on Sept. 23. By constructing and putting the plant into operation within a year, Evans-Wallower is believed to have made a record for new plants of this kind.

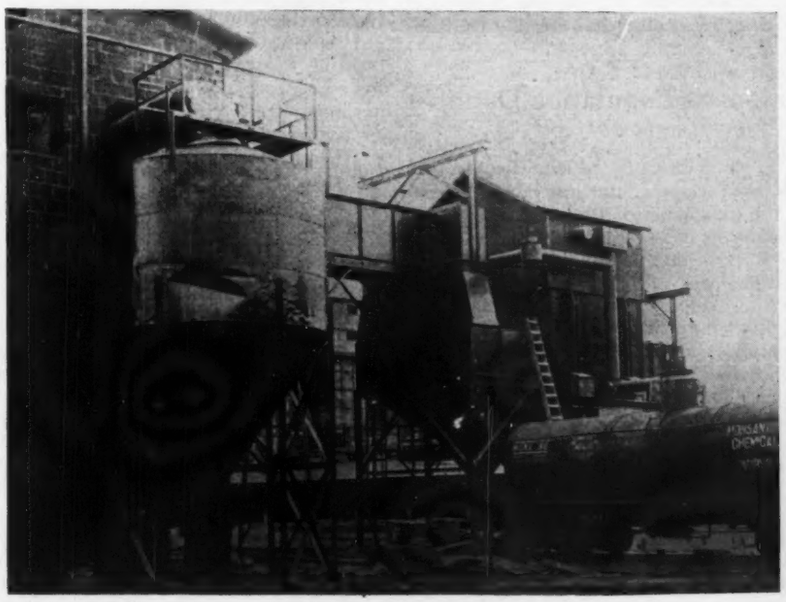
An electrolytic lead plant, to recover the lead content of the residues from the zinc plant, will be started about Dec. 1. A product suitable for conversion into litharge and red lead in the company's Charleston plant will be made.

Broken Hill South to Equip New Shaft Soon

TIMBERING of the new shaft of the Broken Hill South mine, at Broken Hill, New South Wales, Australia, has reached the 725 level, and driving of pilot winzes to the 1,170 level has been completed. The new sections of the mill, housed in a well-constructed steel and concrete mill building, are in operation. Erection of surface equipment to serve the new shaft will begin soon. Distribution of sand filling in the stopes is being reorganized, belt-conveyor installations reducing materially the number of men required for tramming sand.

Owing to the lack of rain in recent months, the mines of the Broken Hill district are again faced with a serious shortage of water.

The Cottrell precipitator at the new Evans-Wallower plant



Two Malayan Tin Areas Change Hands

TWO large alluvial tin areas in the Federated Malay States have recently changed hands. Chankgat Tin Dredging, subsidiary of London Malayan Tin, operating in Lower Perak, has bought an adjoining area, estimated to contain 28,000,000 cu.yd. of tin gravel, for £40,000. The capital of the company will be increased to £300,000 to provide funds for equipping this area with a dredge. The company started dredging on its original ground in March, 1928.

In the other transaction, North Taiping, South Taiping, Taiping, and Klang River acquired 509 areas of dredging ground at Batu, Selangor, for £76,650. The South Taiping dredge will probably be used to work this area, which is estimated to contain 18,500,000 cu.yd. of gravel, averaging $\frac{3}{4}$ lb. per cubic yard. This transfer is expected to be consummated about December, 1930.

Goldfield Con. Options Berengaria Mine

Goldfield Consolidated has taken a three years' option on Berengaria Mines, a silver-lead property near Kootenay Lake, B. C., with Mining Corporation of Canada. According to the agreement, the property will be developed in the same way as the Base Metals property, in which both these companies hold an interest. Goldfield Consolidated will provide 65 per cent of the development funds, and Mining Corporation will provide 35 per cent, with a similar ratio to apply in distribution of stock of any new company formed to take over the mine should exploration be successful.

Climax Mill Enlarged

A new unit, with a capacity of 700 tons daily, has been built at the Climax Molybdenum plant, at Climax, Colo., according to W. J. Coulter, mill superintendent. This makes the total capacity of the plant about 2,000 tons daily. Operation of the new unit will start between Nov. 1 and 15.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Kirkland Lake Gold Hits Ore at 3,800 Ft.—Shaft to Go Down to 4,000 Ft.

TORONTO, ONT., Oct. 19, 1929.—At the Kirkland Lake Gold property, in the Kirkland Lake district, diamond drilling from the 3,625 level has cut the downward continuation of the vein at a point about 200 ft. below. High-grade ore is reported. On the 3,625 level, where 100 ft. of ore, averaging $10 in gold a ton, has been developed, results are considered disappointing. This ore is a continuation of the Teck-Hughes vein, which had been expected to average about $15. The Kirkland Lake shaft is being continued to 4,000 ft. When sinking is completed three new levels will be opened up below the 3,625. The drilling results below this level are important not only to K. L. G. but to Teck-Hughes as well. The greatest depth the latter has obtained is 3,000 ft.

DEVELOPMENT of the rich stringer on the 2,000 level of Lake Shore, also in the Kirkland Lake district, to which reference was made last week, has shown 75 ft. altogether. The stringer is said to average 2 ft. in width, out of a total width of 12 ft. for the oreshoot. Some reports place the average assay in this stringer at about $500 a ton. On the 600 level of the mine, extension of No. 2 vein has been picked up east of the shaft for a length of 54 ft. and a width of about 8 ft. No. 3 vein is proving to be of considerable importance, and a length of 1,200 ft. has been indicated.

A special shareholders' meeting of Aldermac Mines has been called for Oct. 28 in Toronto to consider a by-law authorizing an increase in capital from 3,000,000 to 5,000,000 shares of no-par value. The extra shares will probably be sold to Noranda Mines and Towagmac Exploration, the largest stockholders, at 50c. a share. Development has indicated large low-grade orebodies at this mine.

Noranda directors have announced that a dividend will be paid on or before Jan. 1, 1930. Until certain matters now under consideration are determined, however, the rate of dividend payment will not be announced. Financing of the new Noranda refinery will not affect the dividend policy.

Cobalt Contact, in the Cobalt district of northern Ontario, has made arrangements to ship mill ore to the Mining Corporation smelter. The company has a small mill of its own, but considerable expenditure is necessary for mill changes and to provide for a new water supply, so that in the meantime, to relieve the stopes, a contract has been entered into with Mining Corporation. At present the company has four faces in high-grade ore, and its position is understood to be considerably improved. To date the main production has been cobalt, for which there is a good market.

A small test mill has been erected at the property of Jack Nutt Mines, Ltd., at Bernic Lake, Man., and several tests of tin ore have already been put through the mill. The first run of 10½ tons gave an average head sample of 2 per cent tin, the second test consisted of 12 tons which averaged 1.62 per cent tin, and the third test of 13 tons showed an average of 1.5 per cent tin.

Cerro de Pasco Ends Strike at Morococha

AFTER a strike that lasted three days, work was resumed at the Morococha mines of Cerro de Pasco Copper, in the Province of Yauli, Department of Junin, Peru, on Oct. 16. A compromise was reached on the strikers' demands for higher wages, re-employment of a group of discharged miners, and several other minor points.

Cottrell Plant Installed at Northern Peru Smelter

AT THE Shorey smelter of Northern Peru Mining & Smelting, a subsidiary of American Smelting & Refining, operating near Trujillo, Peru, a Cottrell plant of the plate-treater type has recently been installed. In addition, a Dwight-Lloyd straight line sintering machine is now under construction. When completed it will handle concentrate from the Shorey mill, together with fine oxide ores and flue dust from the Cottrell plant.

The use of the sintering machine on these products will enable the smelter to handle a somewhat greater tonnage and therefore the capacity of the tramway between the Quiruvilca mine and the Shorey smelter has been increased.

Sudbury's Population Doubled in Two Years

AS A RESULT of the heavy and continuous influx of labor caused by the expansion of the nickel industry, in addition to a general revival of mining activity in various parts of the surrounding district, the population of the town of Sudbury, Ont., has grown from slightly more than 8,000 people to a population of approximately 18,000 within the last two years, according to figures just made public by the town assessor. Taxable assessments are mounting at the rate of about $1,000,000 a year. Three families, according to a recent estimate, are moving into the town daily, as a result of the unusual demand for labor created by the International Nickel Company's program alone.

Mexico City Letter

BY W. L. VAIL
Special Correspondent

Low Silver Prices Add to Troubles of Mexican Mine Operators

MEXICO CITY, Oct. 19, 1929.—Dropping of the price of silver during the last week to $15.87 a kilo has seriously disturbed mine operators throughout Mexico. In the first half of the year, silver production from Mexican mines decreased about 300,000 kilos, according to figures just released by the Department of Industry, Commerce and Labor. This decline, of course, resulted largely from the revolution, which affected shipments from small operators, and from the exhaustion of several mines. But with the new labor law in the offing, and with taxation at what many producers consider an excessive rate, the low price has not lessened the gloom among Mexican silver producers.

ONE complaint recently made to Treasury officials in regard to taxation is that, although production from flotation plants and smelters is taxed at the rate of 5.25 per cent, production from leaching, amalgamation, and cyanidation plants pays only 2.25 per cent. Government officials in the finance and mining departments are lending a sympathetic ear to these complaints. One company is said to have proposed that an act similar to the Pittman Act of the United States be passed. Lower railroad rates are being asked, and the familiar demand for curtailed production is also heard.

A report has been published in the local press that American Smelting & Refining is preparing to move the smelter at San Luis Potosi back to its Aguascalientes unit. This rumor has been vigorously denied by representatives of the company in this city.

Preparations are being made for treating the dumps on the famous Creston Colorada mine of Dolores Esperanza, at Torres, Sonora, according to reports from that state. No work has been done on this property for the last three or four years, although previous to that it had a remarkable production record of about 100 years.

Equip Overman Shaft

Equipment of the Overman shaft, on the Comstock Lode, Virginia City, Nev., is being undertaken preparatory to exploration from the 1,200 level. A small electric hoist is being installed and the shaft is being repaired. A crosscut will then be driven to the "Black" dike. Drifting along the dike will be undertaken in the direction of the American Flat section, formerly the property of United Comstock, and now owned by Savage, Gould & Curry.

MARKET AND FINANCIAL NEWS

World Copper Output in September 174,853 Tons

WORLD production of copper in September totaled 174,853 tons, which compares with 174,329 tons in August and 196,820 tons in April, the peak for the year. Daily rate of production for September, according to the American Bureau of Metal Statistics, was 5,828 tons, against 5,624 tons in the preceding month and 5,957 tons, the average for the first nine months of the year.

Copper production, in tons, by countries, for August and September, follows:

	August	September
United States	91,735	92,538
Mexico	5,018	5,018
Canada	7,770	6,949
Chile and Peru	30,971	30,801
Japan	7,166	7,291
Australia	1,421	1,257
Europe(a)	13,800	12,800
Belgian Congo	13,448	14,109
Elsewhere(b)	3,000	3,000
Total	174,329	174,853

(a) Incomplete and partly estimated.
(b) Estimated.

Production of copper throughout the world in the first nine months of the year totaled 1,626,189 tons, against 1,916,471 tons for the whole of 1928 and 1,694,346 tons for the year 1927.

Magma Copper Earnings Gain Over Last Year

MAGMA Copper Company reports for the quarter ended Sept. 30, 1929, net earnings of $786,802 after expenses and depreciation, but before federal taxes, comparing with $813,737 in the preceding quarter and $551,943 in the September quarter of 1928.

Net earnings for the first nine months of 1929 totaled $2,592,576 before the federal taxes, against $1,428,968 in the corresponding period last year.

In the third quarter, the company produced 9,864,574 lb. of copper at a cost of 9.79c. a pound, with gold and silver credited to copper and after depreciation and all fixed and general expenses but before federal taxes. In the second quarter Magma produced 9,892,826 lb. of copper at a cost of 9.58c. figured on a similar basis, and in the first quarter 9,722,101 lb. at cost of 9.24c.

Kerr Lake Mines, Ltd., Reports Loss for Year

Kerr Lake Mines, Ltd., operating silver properties in northern Ontario, reports for year ended Aug. 31, 1929, net loss of $1,270 after administration and general expenses. This compares with net profit of $238,100 on 600,000 shares in previous year. Profit-and-loss account shows surplus of $1,096,988.

Kerr Lake Mining Company, Ltd., controlled by Kerr Lake Mines, Ltd., reports net loss of $3,150 for year ended Aug. 31, 1929, after expenses in connection with maintenance of mine, taxes, and other charges, against a net loss of $31,529 in the previous year. Profit-and-loss surplus at the end of the fiscal year was $7,451.

Silver Production in U. S. Declines in September

SILVER production in the United States in September amounted to 4,172,000 oz., against 5,006,000 oz. in August and 4,087,000 oz. in August of last year, according to the American Bureau of Metal Statistics. Production in Canada in September totaled 2,081,000 oz., which compares with 2,744,000 oz. in the preceding month.

World production of silver in July, the latest month for which figures for all countries are available, was 22,057,000 oz. This compares with an output of 18,457,000 oz. in July, 1928. Production in July of the current year, in ounces, by countries, follows: Mexico, 11,943,000; United States, 4,523,000; Peru, 1,949,000; Canada, 1,910,000; Australia, 751,000; Burma, 581,000, and Bolivia, 400,000.

QUICKSILVER IMPORTS into the United States in the first half of 1929 amounted to 322,082 lb., valued at $431,506, which compares with 546,304 lb., valued at $721,986, in the similar period last year.

GOLD PRODUCTION IN THE UNITED STATES in 1928, according to the final estimate of the Mint, totaled 2,233,251 oz., valued at $46,165,400.

THE TIN ASSOCIATION has issued a denial of rumors of dissension among the members of the council or executive committee and states that decline in tin prices cannot therefore be attributed to this cause. So far the executive committee has directed its attention to research, statistics, and publicity.

UNION MINIÈRE DU HAUT-KATANGA produced 14,106 short tons of copper in September, against 13,444 tons in August and 13,216 tons in July. Output of this African copper producer for the first nine months of the current year totaled 112,184 tons, which compares with 96,574 in the same period of 1928.

Ontario Gold Output Up in September

ONTARIO gold production for September was valued at $2,702,334, against $2,502,665 for September of last year, according to the Ontario Department of Mines. This brings the total for the first nine months of the current year to $24,726,698, which compares with $23,748,486 in the corresponding period of 1928. Ore mined in the nine months' period totaled 3,012,720 tons, against 3,140,161 tons in the like period last year.

During September producing mines in order of output, by districts, were: Porcupine—Hollinger, McIntyre, Dome, Vipond, Coniaurum, March, West Dome, and Porcupine United. Kirkland Lake—Lake Shore, Teck-Hughes, Wright-Hargreaves, Sylvanite, Kirkland Lake Gold, and Barry-Hollinger.

McIntyre Porcupine Profit Up in First Six Months

McINTYRE Porcupine Mines, Ltd., Canada, reports net earnings for the quarter ended Sept. 30, 1929, of $529,251, against $470,112 for the first quarter of the current fiscal year, making a total for the half year of $999,363. This compares with net earnings of $980,997 in the first half of the preceding year.

The statement covering the six months ended Sept. 30, for this year and 1928, follows:

	Six Months 1929	Six Months 1928
Gross income	$2,175,472	$2,109,506
Costs incl. development	1,176,109	1,128,508
Net earnings	999,363	980,997
Taxes for period	59,820	50,465
Net before depreciation	939,542	930,532

Net earnings for the six months, after deducting taxes but before depreciation, showed a gain of $9,010.

ALASKA JUNEAU in September, 1929, mined and trammed to mill 323,790 tons, from which estimated receipts were $310,500, or 95.90c. per ton. Operating expenditures totaled $173,000, or 53.43c. per ton, and operating profit, $137,500, or 42.47c. per ton. Other expenditures and accrued charges were $19,500 for the month, leaving to surplus $118,000.

THE INTERSTATE IRON & STEEL COMPANY, Chicago, held a special meeting of the stockholders recently at which the sale of the company to the Central Alloy Steel Corporation was ratified. The Central Alloy Steel Corporation is controlled by the Eton group of capitalists, who also control Republic Iron & Steel.

London Financial News

G. H. GREEN
Special London Correspondent

LONDON, Oct. 8, 1929.—The announcement recently made that the London Tin Syndicate is to absorb the Northern Nigeria Bauchi Tin Mines has not met with a good reception in the market. The Syndicate, which not long ago acquired the Ropp Tin, is gradually swallowing up all the big producers in Nigeria and will now control practically 90 per cent of the output of that country. Few interested in the market like to see all the shares previously dealt in being gathered under one hat, so to speak.

The Bauchi is apparently within sight of the exhaustion of its richest ground, and its existing hydro-electric station at Kwall Falls is not big enough to deal with the large additional area belonging to the company. Consequently, on the completion of the negotiations this asset will be segregated and a separate company will be formed to raise sufficient funds to double its capacity. In this undertaking, Bauchi shareholders will be given an opportunity to participate. The London Tin and its associate undertaking, the Anglo-Oriental Mining Corporation, dominate the position in Nigeria, but as this country produces only 4 or 5 per cent of the world's supplies, the further acquisition is of comparatively little importance. The group, however, is mainly responsible for the formation of the Tin Producers' Association, having for its object the stabilization of the metal price, and, through its Malayan interests, has obtained a good measure of support from the East. If the plan is successful, the Nigerian companies may do well, but to secure this result the price of tin must be stabilized at a considerably higher level than that now ruling.

According to plan, the New Guinea Goldfields has been incorporated to take over control of the locally formed company, which is to operate the big gold property, the Edie Goldfield, in North East New Guinea, and previously known as the Ellyou. Leslie Urquhart and his associates on the Russo-Asiatic board, the Mining Trust and the Mount Isa, are evidently prepared to face the difficulties which the development of the properties present. An airplane service has been installed, and a railway is being surveyed. The properties are some 30 miles in a direct line from the coast, but owing to the difficult tropical country, the railway will have to be 120 or 130 miles in extent and will cost probably £400,000 to construct. The deposits, according to periodical reports, are very rich, and are expected to warrant the large initial capital outlay.

After an inglorious career extending over six years, the Porcupine Goldfields Development & Finance Company is proposing to go into voluntary liquidation, as the assets of the company are insufficient to meet its note issue. This company found its original investments in British Porcupine Development, Canadian Gold Mines, and Ankerite Gold Mines unremunerative, and turned its attention to the Stemwinder lead-zinc mine at Kimberly, B. C., but after operations had been suspended for some time, this undertaking was disposed of to the owners of a neighboring property.

The interim dividend of 25 per cent just declared by the Rio Tinto compares with 15 per cent a year ago, and the announcement came as a pleasant surprise to the market. The company is evidently doing well, as the distribution is on a larger capital, an additional £250,000 having been raised in June last to finance the company's participation in the Northern Rhodesian copper fields. The ordinary capital is now £2,125,000 in £5 shares.

Apparently Amalgamated Zinc (De Bavay) should take steps to change its name, as its active operations on the tailings and dump slimes at Broken Hill, N.S.W., ceased in 1924, and two years later it distributed its Electrolytic Zinc shares among its shareholders. Since then it has been investigating the possibilities of paper-pulp manufacture in Tasmania.

GYPSUM SHIPMENTS FROM CANADIAN deposits during 1928 totaled 1,246,368 tons, valued at $3,743,648, and set a new high record for the industry, according to revised statistics by the Dominion Bureau of Statistics. Production in 1927 amounted to 1,063,117 tons, valued at $3,251,015. Gypsum quarried in 1928 totaled 1,311,642 tons, of which quantity 226,997 tons, or 17.3 per cent, was calcined in Canada.

UNITED STATES SMELTING, REFINING & MINING COMPANY reports for the eight months ended Aug. 31, 1929, consolidated net profit of $3,046,509 after interest, depreciation and other charges, equivalent after 7 per cent preferred dividend requirements, to $3.08 a share on 620,562 common shares outstanding at the end of the period. This compares with net profit of $2,369,678, or $3.51 a share, on 351,117 common shares in the first eight months of 1928.

MINERALS PRODUCED IN TASMANIA for the quarter ended June 30 were valued at £440,986. The principal items were 2,143 tons of copper, valued at £185,271, and 1,874 tons of zinc, valued at £52,898. In addition, the Electrolytic Zinc Company recovered 12,135 tons of zinc, valued at £345,695, and 45 tons of cadmium, valued at £20,228, from other than Tasmanian ores.

NORTH MOUNT FARRELL, operating a lead-zinc property at Tullah, Tasmania, made a net profit of £4,812 during the year ended June 30, as compared with a loss of £3,971 for the preceding year. The flotation plant treated about 48,000 tons of ore and tailing, for a production of 1,826 tons of lead concentrate and 1,992 tons of zinc concentrate.

NEW CAPITAL INVESTED IN MINING enterprises in the United Kingdom in the first nine months of the current year totaled £9,939,000, which compares with £5,750,900 in the similar period last year, according to *The Economist*.

Non-Ferrous Metals Output in Mexico Shows Drop

PRODUCTION of gold, silver, lead, copper, and zinc in Mexico in the first half of 1929 registered a decline, contrasted with the same period last year, the lessened activity being attributed chiefly to the interruption in ore shipments by small mines which occurred when the revolution was in progress. The fall in the price of silver also was a factor.

Mexican output of non-ferrous metals for the first half of the year, compared with the same period last year, according to the Secretary of Industry, Commerce and Labor of Mexico, follows:

	Jan.-June 1929 Kilograms	Jan.-June 1928 Kilograms
Gold	8,896	11,170
Silver	1,391,848	1,700,212
Lead	99,500,179	118,591,969
Copper	24,257,616	30,652,975
Zinc	57,989,039	78,199,699
Quicksilver	39,756	42,145
Antimony	1,313,283	1,389,704
Arsenic	4,703,024	3,923,082
Cadmium	192,430	162,551
Tin	4,853	.....
Selenium	148	.....
Vanadium	806	.....

Production of graphite in Mexico in the first half of 1929 amounted to 2,499,494 kg., against 3,756,416 kg. in the same period last year.

World Zinc Production Holds at High Level

WORLD production of zinc in September was 133,115 tons, of which total the United States produced 53,285 tons and the rest of the world 79,830 tons. World production in the preceding month was 136,304 tons, and the monthly average for the first nine months of this year was 134,160 tons, according to the American Bureau of Metal Statistics. The monthly average for the whole of 1928 was 131,382 tons.

Output of zinc, by countries, for August, September, and the nine months ended with Sept. 30, in short tons, follows:

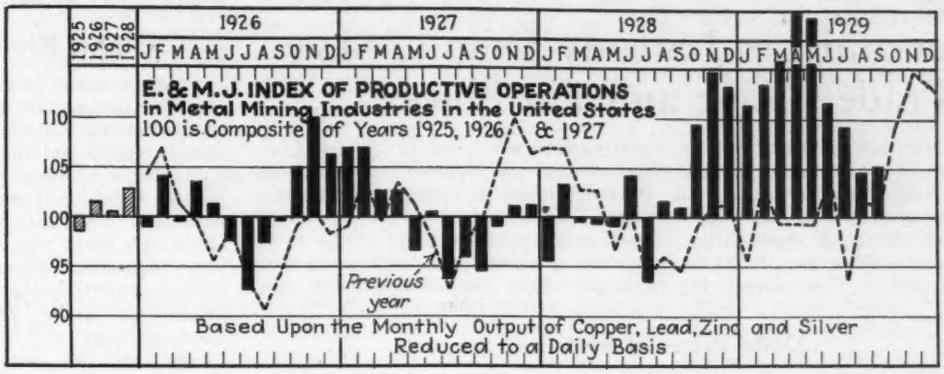
	August, 1929	September, 1929	Jan.-Sept. 1929
United States	55,290	53,285	480,914
Canada	7,144	7,674	66,381
Mexico	1,474	1,407	12,003
Belgium	17,645	17,545	162,998
France	7,821	7,220	74,696
Germany (a)	9,997	9,648	87,051
Great Britain	5,607	5,281	49,711
Netherlands	2,298	2,114	21,180
Poland(a) (b)	16,827	16,695	146,762
Spain	1,125	1,118	9,701
Australia	4,861	4,838	42,805
Rhodesia	1,215	1,260	9,735
Elsewhere (c)	5,000	5,000	43,500
Total	136,304	133,115	1,207,437

(a) Includes zinc dust. (b) Includes production of Polish Silesia. (c) Estimated.

THE WORLD'S VISIBLE SUPPLY OF TIN on Oct. 1 amounted to 24,057 tons, against 25,901 tons a month previous and 19,777 tons on Oct. 1, 1928, according to Ricard & Freiwald, London. Two years ago the visible supply totaled 15,432 tons.

Indicators of Industrial Activity

of Significance to Mining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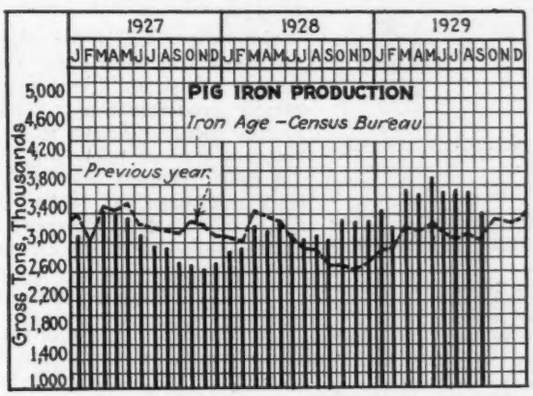
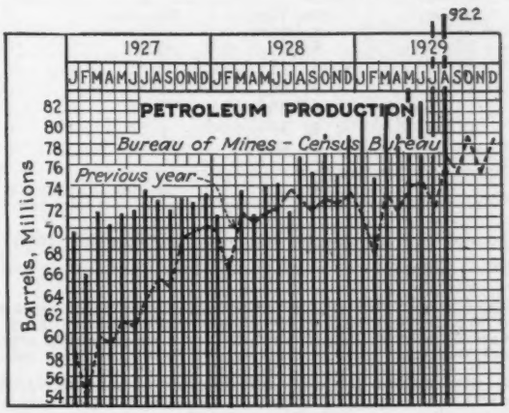
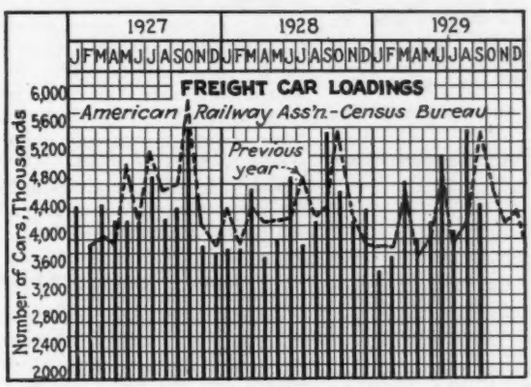
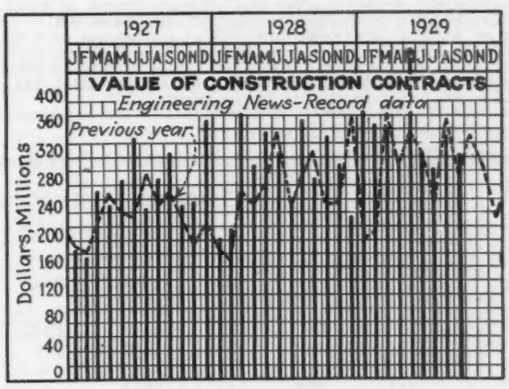
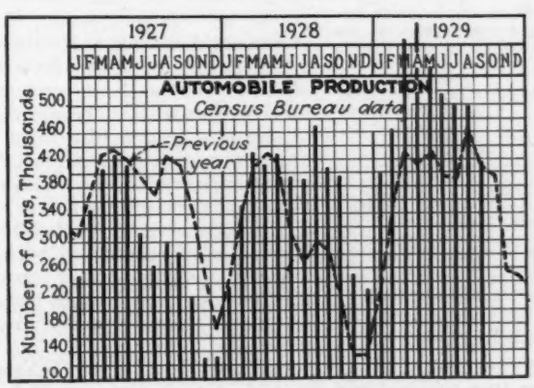
E. & M. J. INDEX OF PRODUCTIVE OPERATIONS
in Metal Mining Industries in the United States
100 is Composite of Years 1925, 1926 & 1927
110
105
100
95
90
Previous year
Based Upon the Monthly Output of Copper, Lead, Zinc and Silver
Reduced to a Daily Basis

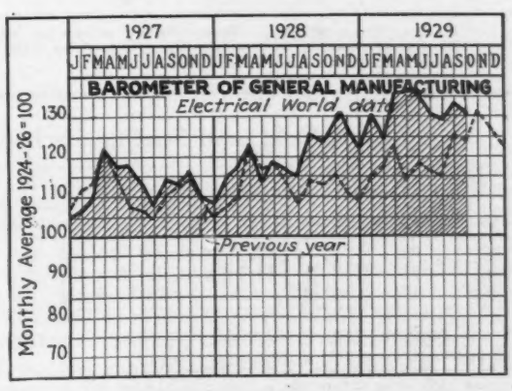












The Market Report

Copper and Lead Steady Despite Slow Trade—Zinc and Tin Lower

New York, Oct. 23, 1929.—Developments outside of the metal markets exerted marked influence on trading, and business in the past week, taken as a whole, fell far short of expectations. Disturbing factors were the sharp decline in securities in Wall Street, the continued unsettlement in London financial circles, and the resignation of the Briand Cabinet in France. In London, prices for the major non-ferrous metals were under pressure most of the week, but the situation here underwent little change. Both copper and lead ruled firm, with shipments to consumers at a high rate. Zinc was reduced in price to bring the market in line with the import parity. Tin moved into new low ground, but some good business was placed on the decline.

Daily Prices of Metals

Oct.	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
17	17.775	41.50	6.90	6.70	6.80
18	17.775	41.125	6.90	6.70	6.80
19	17.775	41.00	6.90	6.70	6.80
21	17.775	40.25	6.90	6.70	6.70
22	17.775	41.375	6.90	6.70	6.70
23	17.775	41.875	6.90	6.70	6.70
	17.775	41.188	6.900	6.700	6.750

Average prices for calendar week ending Oct. 19, 1929, are: Copper, 17.775c.; Straits tin, 41.708c.; New York lead, 6.900c.; St. Louis lead, 6.700c.; zinc, 6.800c.; and silver, 49.833c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms of wirebars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight differential. Contract prices for High-Grade zinc delivered in the East are 1@1½c., depending upon purity, above St. Louis prices for Prime Western.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Oct.	Copper		Electrolytic	Tin		Lead		Zinc	
	Standard								
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
17	72 7/16	73	84	187¾	192	23 5/16	23½	22⅞	23⅛
18	72½	72¾	84	184¾	189	23⅜	23⅝	22⅞	23 1/16
21	71½	71 9/16	84	181½	185½	23⅜	23 1/16	22½	22 9/16
22	71 9/16	71 11/16	83¾	182	186	23 1/16	23 1/16	22⅜	22½
23	73 1/16	73 1/16	83¾	189½	193¾	23 9/16	23½	22⅜	22¾

Prices for lead and zinc are the official closing prices for the morning session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

Silver, Gold, and Sterling Exchange

Oct.	Sterling Exchange "Checks"	Silver		Gold London	Oct.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
17	$4.86⅜	49⅛	23	84s 11½d	21	$4.86⅞	49⅜	22 15/16	84s 11½d
18	4.86½	50	23 1/16	84s 11½d	22	4.87¼	49⅞	22 15/16	84s 11½d
19	4.86¼	49⅛	22 15/16	.....	23	4.87⅛	50	23	84s 11½d

Average: Silver, 49.813c.; Sterling Exchange, $4.86813

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Copper Remains Quiet

Sales of copper again were well below the average, but no change occurred in the general situation and prices were firmly maintained on the basis of 18c. Connecticut Valley and 18⅛c. in the Middle West. Shipments to consumers, with but few exceptions, are going ahead at a good rate, and producers believe that actual consumption and production are well balanced. The electrical industry is largely responsible for the sustained high rate of consumption of copper, and the outlook there is most favorable. Brass manufacturers have suffered somewhat because of the decline in operations in the automotive industry.

Domestic demand for copper during the week was mostly for October-November shipment, with the current month predominating. The call for prompt metal indicates that consumers' reserves are extremely low.

Export business was dull, with the price unchanged at 18.30c. per pound, c.i.f. basis. Sales for export so far this month totaled about 18,000 tons.

Zinc Down 10 Points

On Monday the market for zinc was reduced to 6.70c. per pound, St. Louis, a decline of ten points. The lower market here was brought about by the recent weakness in London, the price abroad having reached a point where importations would have been possible, though hardly practicable. The buying continued moderate, but the fact that the sales total for the week did register some improvement was encouraging to producers. High-grade, 99.99 per cent, is available at a premium of 1.15c. above St. Louis Prime Western prices, for all ordinary consuming points.

Lead Demand Quieter

A fair tonnage of lead has been sold in the last week, comparing very favorably, in fact, with sales of other metals, but the total business has been considerably less than sellers have reported for other recent weeks. The American Smelting & Refining contract price remains at 6.90c., New York, and all sales in the East have apparently been on that basis. The principal sellers of chemical lead in the West also continue to maintain the 6.70c., St. Louis, quotation, though on Thursday and Friday a firm offer of 6.65 or 6.675c. might have been considered favorably by dealers. Demand has been well distributed among cable, paint, foil, ammunition, and mixed-metal manufacturers. Some battery makers are specifying rather more than was expected on contracts, but others seem to be feeling the full force of the automobile curtailment.

Shipments of lead to domestic consumers will again be heavy in October—well over 60,000 tons in all probability. Sales so far this month, however, have been comparatively light; and so far only about a third of normal open-market business for November has been booked. The indications, therefore, are that consumers are holding off in their buying as long as possible, in the hope that a weakening in the price structure of other metals, particularly abroad, may affect the lead market. Unless London declines sharply, however, which there is no reason to expect, lead prices give every evidence of remaining firm.

Tin Near 40c. Monday

Tin had no support in London, and with free offerings the spot price dropped to £181 10s. on Monday, with sales here as low as 40½c. This encouraged some buying and short covering abroad, with a resultant advance to 41c. here next morning. Thinking the low point had been reached for the present, consumers entered the market for a good tonnage yesterday, and the price has advanced further. Most of the buying has been for near-by delivery, as premiums of about ¼c. a month have been asked for futures, but some buyers feel that tin is now a good buy for six months ahead and have booked orders for delivery up to May.

Silver Slightly Steadier

The silver market has continued quiet and inactive, with a slightly steadier undertone. Moderate buying for China account has been the chief support of the market, and India has been inclined to follow China's lead.

Mexican Dollars (old Mexican pesos): Oct. 17th, 36½c.; 18th, 37⅛c.; 19th, 36½c.; 21st, 36⅜c.; 22d, 37c.; 23d, 37⅛c.

Foreign Exchange

Closing cable quotations on the leading Continental exchanges on Tuesday, Oct. 22, were: Francs, 3.93¾c.; lire, 5.23⅞c.; and marks, 23.90c. Canadian dollars, 1⅛ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c.

ANTIMONY—Per lb., duty paid, New York: Chinese brands, 8⅝c. per lb. for spot and future shipments. Good business placed during week and prices have been advanced ¼c. for all positions. The political situation in China had a strengthening influence on the market. Cookson's "C" grade, spot, 14c.

BISMUTH—Per lb., New York, in ton lots, $1.70. Smaller lots, $1.80 and up.

CADMIUM — Per lb., New York: 80@90c. Active demand.

IRIDIUM — Per oz., $220@$230 for 98@99 per cent sponge and powder.

NICKEL — Per lb., ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $35@$37. Small lots bring up to $46.

PLATINUM — Official price quoted by the leading interest on small orders for refined metal is $65 per oz. Transactions between dealers and refineries in the outside market are reported at several dollars less.

QUICKSILVER — Per 76-lb. flask, $124@$125. Demand slow. Small lots command the usual premiums.

Prices of Chromium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Titanium, Tungsten, Vanadium, and Zirconium are unchanged from the issue of Oct. 5.

Metallic Ores

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, $15.25@$15.50 for future shipment. Near-by offerings light and prices are firm despite quiet trade. Bolivian scheelite, $15.50@$15.75, Nov.-Dec. shipment. Western scheelite, $16.50 for Jan. shipment.

Antimony, Chrome, Iron, Manganese, Tantalum, Titanium, Vanadium, and Zircon ores are unchanged from quotations in the Oct. 5 issue.

Platteville, Wis., Oct. 19, 1929

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$46.75
Lead Ore	
Lead, basis 80 per cent	$90.00

Shipments for the week: Blende, 663 tons; lead, none. Shipments for the year: Blende, 27,335; lead, 1,660 tons. Shipments for the week to separating plants, 1,660 tons blende.

Tri-State Sellers Withholding Flotation Concentrate

Joplin, Mo., Oct. 19, 1929

Blende	Per Ton
High	$46.35
Premium blende, basis 60%	44.00
Prime Western, basis 60%	$43.00@ 44.00
Table concentrate, 60%	42.00@ 43.00
Flotation concentrate, 60%	40.00@ 41.00
Average settling price, all	44.43
Galena	
High	$88.90
Basis 80% lead	87.50
Average settling price, all	87.61

Shipments for the week: Blende, 12,441 tons; lead, 1,516 tons. Value, all ores the week, $684,290.

The producers of three-fourths of the output of flotation concentrate are refusing to accept $41, but aside from this no price change is reported. Withdrawal of approximately 2,600 tons of this material from sale is creating a stronger competition for coarse concentrates. The result is favorable to Prime Western grades, an increased tonnage moving at higher prices. Weekly production is approximately 13,000 tons, 500 to 600 tons more than the shipment. However, stocks in the bins at the mines are only 42,000 to 43,000 tons compared with 58,000 tons a year ago.

Lead concentrate is in active demand on $87.50 basis, with several producers declining this offering. Stocks are close to 6,000 tons.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, and Tripoli are unchanged from prices in the Oct. 5 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic)—Per lb., 4c. Good contract business and prices holding firm.

SODIUM NITRATE — Per 100 lb., $2.10 for prompt delivery.

Antimony Oxide, Calcium Molybdate, Copper Sulphate, Sodium Sulphate, and Zinc Oxide are unchanged from prices in the Oct. 5 issue.

Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $105. Spiegeleisen, 19@21 per cent, $34 f.o.b. furnace on carload business.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.45@$1.50, f.o.b. works.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferrovanadium, Nickel Silver, and Yellow (Muntz) Metal are unchanged from prices in the Oct. 5 issue.

Rolled Metals

Copper, lead, zinc, Monel metal, and nickel sheets, and copper wire are unchanged from prices in the Oct. 5 issue.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of Oct. 5.

Iron, Steel, and Coke

IRON—Per gross ton, Valley furnaces: Bessemer, $19; basic, $18.50; No. 2 foundry, $18.50.

STEEL — Base prices per gross ton, Pittsburgh, billets and slabs, $35; plates, structural shapes, and soft steel bars, per 100 lb., $1.95.

COKE — Per gross ton, Connellsville furnace, $2.65@$2.75. Connellsville foundry, $3.75@$4.85. Byproduct coke, Ohio and Kentucky (Connellsville basis), $6.50; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ended October 19, 1929

Stock	Exch.	High	Low	Last	Last Div.
COPPER					
Anaconda Copper	New York	117¼	106½	107¾	Oc. 11 No. 18 Q 1.75
Andes Copper	New York	52½	48¾	48¾	Oc. 11 No. 11 Q 0.75
Arizona Com	Boston	1⅛	1	1⅛	Jl. 16 Jl. 31 SA 0.25
Calumet & Ariz	New York	123¾	120¾	120¾	Se. 6 Se. 23 Q 2.50
Claumet & Hecla	New York	42¾	40¼	40¼	Au. 31 Se. 30 Q 1.00
Cerro de Pasco	New York	92¾	85	85	Oc. 10 No. 1 Q 1.50
Con. Coppermines	N. Y. Curb	9	8½	9	
Copper Range	Boston	22½	21½	21¾	Se. 14 Oc. 15 Q 0.50
East Butte	Boston	2	1½	1⅝	Dec., 1919 0.50
Granby Con	New York	87½	78¼	78½	Oc. 18 No. 1 Q 2.00
Greene Cananea	New York	179	173	173	Se. 12 Oc. 7 Q 2.00
Howe Sound	New York	61¾	55	55	Se. 30 Oc. 15 Q 1.00
Hudson Bay	N. Y. Curb	16¾	16	16	
Inspiration	New York	43½	37¾	37¾	Se. 9 Oc. 7 Q 1.00
Isle Royale	Boston	21½	20½	20¾	Au. 31., Se. 30 0.50
Kennecott	New York	84¾	76¼	76¼	Au. 30, Oc. 1 Q 1.25
Magma Copper	New York	73¾	68¼	69	Se. 30, Oc. 15 Q 1.25
Mason Valley	N. Y. Curb	2	2	2	
Miami Copper	New York	42¾	39½	39½	No. 1, No. 15 Q 1.00
Mohawk	Boston	61¼	59½	61	Oc. 3, De. 2 3.00
Mother Lode	New York	2½	2¼	2¼	Je. 13, Je. 29 0.20
Nevada Con	New York	48¾	41¼	41¼	Se. 18, Se. 30 Q 0.75
Noranda	N. Y. Curb	49½	44¼	44¼	
Ohio Copper	N. Y. Curb	1¼	1⅛	1⅛	Sept., 1926 0.03
Old Dominion	Boston	9	8½	8⅞	Dec., 1918 1.00
Phelphs Dodge	New York	63	58	58½	Se. 4, Oc. 1 Q 0.75
Quincy	Boston	46¾	42	42¾	March, 1920 1.00
Roan Antelope	N. Y. Curb	41¾	39¾	39¾	
St. Mary's M. L.	Boston	37½	35	35	Fe. 25, Mr. 12 2.00
Seneca Copper	New York	4¾	4¼	4¼	
Shattuck Denn	N. Y. Crb	13½	13	13	
Sheritt-Gordon	Toronto	6.50	5.45	5.60	
Tenn. C. & C.	New York	17⅜	16½	16½	Au. 31, Se. 16 Q 0.25
United Verde Ex.	N. Y. Curb	15¼	14⅛	14⅛	Oc. 2, No. 1 Q 1.00
Utah Copper	New York			325	Se. 18, Se. 30 Q 4.00
Waite-Ack.-Mont.	Toronto	5.00	4.50	4.50	
Walker Mining	Salt Lake	6.10	6.00	6.00	
Wenden Copper	N. Y. Curb	1.00	*87½	*93¾	
LEAD, ZINC, SILVER					
Ahumada Lead	New York	1½	1½	1½	
Amer. Z. L. & S.	New York	22¾	17⅛	17⅛	May, 1917 1.00
A. Z. L. & S., pfd.	New York	97¾	92	93	Se. 19, Oc. 1 Q 1.50
Bunker Hill & S.	N. Y. Curb	135	125½	125½	Se. 27, Oc. 5 MX 0.75
Butte Cop. & Zn.	New York	4	3¾	3¾	
Butte Cop. Con.	Boston Curb	*43¾	*25	*31¾	
Butte & Sup.	New York	7	6¼	6¼	Je. 14, Je. 29 Q 0.50
Callahan Zn-Ld.	New York	2	1⅞	1⅞	Dec., 1920 0.50
Chief Consol.	Salt Lake	3.00	3.00	3.00	Fe. 1, 1918 K 0.10
Consol. Ld. & Zn. "A"	St. Louis	10⅜	9	10⅜	Se. 20, Oc. 1 Q 0.25
Constitution	Spokane	*42	*40	*40	
Dayrock	Spokane	3.25	3.00	3.00	Je. 20, Je. 30 0.03
Dickens Consol.	Spokane	*91	*8½	*8½	
Eagle-Picher	Cincinnati	17	16	17	Se. 30, Oc. 15 Q 0.20
Eagle-Pich., pfd.	Cincinnati			102	Se. 30, Oc. 15 Q 1.50
Erupcion	Boston Curb			*12	Jan. 1, 1928 0.07½
Eureak Bullion	Salt Lake	*8	*85	*85	
Evans-Wallower	N. Y. Curb	16½	15½	15½	
Evans-Wal., pfd.	N. Y. Curb			80	Je. 20, Jl. 1 Q 1.75
Federal M. & S.	New York	2.20	2.20	2.20	June, 1927 10.00
Fed. M. & S., pfd.	New York	98	97½	97½	Au. 23, Se. 16 Q 1.75
Gladstone	Spokane	*3½	*3⅛	*3⅛	
Golconda	Spokane	*93	*87	*89	Je. 15, Jl. 1 0.02
Grandview	Spokane	*26	*23	*23	
Hecla Mining	N. Y. Curb	16¾	16	16	Au. 15, Se. 15 Q 0.25
Highland-Surprise	Spokane	*13¾	*1 ⅜	*12½	
Jack Waite	Spokane	*14¾	*13½	*13¾	
Kootenay Florence	Spokane	*10	* 9	* 9	
Lucky Jim	Spokane	*12	*10	*10	
Lucky Tiger-C	Kansas City	†3.00	†2 87½		Oc. 10, Oc. 20 M 0.02½
Mexican Premier	Spokane	2.20	2.13	2.13	
National Lead	New York	210	184	184	Se. 13, Se. 30 Q 1.25
Natl. Lead, pfd. A	New York	140¾	139	140	v. 29, De. 14 Q 1.75
Natl. Lead, pfd. B	New York	117½	116	116½	Oc. 18, No. 1 Q 1.50
N. J. Zinc, new	N. Y. Curb	83½	78½	78½	Oc. 21, No. 9 Q 0.50
New Quincy	Salt Lake	3.00	1.67	1.80	Se. 20, Se. 30 Q 0.10
Noble Five	Spokane	*53	*49	*49	
North Lily	Salt Lake	5.25	4.97½	4.97½	Oc. 16, Oc. 23 0.25
Park Bingham	Salt Lake	9¾	7	9¾	
Park City Con.	Salt Lake	1.70	1.50	1.50	
Park Utah	New York	6¾	4½	5½	Dividends suspended
Pend Oreille	Spokane	3.90	3.50	3.50	
Rico Argentine	Salt Lake	1.27	1.25	1.25	No. 30, De. 15 Q 0.03
Ruth-Hope	Spokane	*32	*23	*23	
St. Joseph Lead	New York	80	71	72¾	Se. 10, Se. 20 QX 0.75
Sherman Lead	Spokane	*90	*88	*89	
Silver King Coa	Salt Lake	12¾	12½	12¾	Se. 20, Oc. 1 Q 0.25
Silversmith	Spokane	*8	*7½	*8	Oct., 1926 0.02
Sunshine Mining	Spokane	6.96	6.25	6.96	Se. 10, Se. 20 Q 0.05
Tamarack-Custer	Spokane	*72	*61	*64	Sept., 1924 0.25
Tintic Standard	Salt Lake	13¾	12½	12½	Se. 17, Se. 20 X 0.30
Tonopah Belmont	N. Y. Curb	*93½	*93½	*93¾	Oct., 1925 0.05
Treadwell-Yukon	Toronto	8.00	7.75	7.75	
United Zinc Smg, New	N. Y. Curb	8¼	8⅛	8⅛	
Utah Apex	Boston	5¼	3⅞	4⅛	Oc. 15, No. 1 0.25
Utah Met. & Tun.	Boston	*97	*80	*80	Dec., 1927 0.30
Whitewater	Spokane	*42	*25	*25	
Yellow Pine	Los Angeles			*8	Dec., 1925 0.04
GOLD					
Alaska Juneau	New York	8	6¾	6¾	
Barry-Hollinger	Toronto	*22½	*20	*21	
Central Manitoba	Toronto	*30	*22	*25	
Cresson Consol.	N. Y. Curb	*50	*43¾	*50	Se. 30, Oc. 10 Q 0.02
Dome Mines	New York	8¾	8⅛	8⅛	Se. 30, Oc. 21 Q 0.25
Golden Cycle	Col. Springs	†1.67½	†1.62½		Au. 31, Se. 10 Q 0.04
Hollinger	Toronto	5.70	5.50	5.50	Oc. 18, No. 4 FW 0.05
Homestake	New York	85	84	84	Oc. 19, Oc. 25 M 0.50
Kirkland Lake	Toronto	*73	*55	*61	
Lake Shore	Toronto	23	22½	22½	Se. 17, QX 0.42
McIntyre Porcupine	New York	15	15	15	Nv. 1, De. 2 Q 0.25
Portland	Col. Springs	†*8½	†*7		April, 1927 0.01
Rand Mines	New York			35½	Au. 21, 29 A.s. 1.50
Siscoe	Toronto	*84	*67	*71½	
Sylvanite	Toronto	*73½	*67	*73	
Teck-Hughes	Toronto	6.40	5.55	5.70	Oc. 18, No. 1 0.15
Tom Reed	Los Angeles	*65	*62½	*65	Dec., 1926 0.02
Unity Gold	N. Y. Curb	1.00	*75	*75	
Vipond Consol.	Toronto	*83	*73½	*73½	April, 1927 0.03
Wright-Hargreaves	Toronto	1.55	1.40	1.45	Oc. 16, No. 1 0.02½
Yukon-Alaska	N. Y. Curb			35½	
GOLD AND SILVER					
Carnegie Metals	N. Y. Curb	15	14½	14½	
Castle-Trethewey	Toronto	*29¾	*29½	*29½	
Consol. Cortez	N. Y. Curb			*12½	
Dolores Esperanza	N. Y. Curb	*75	*37½	*75	July, 1923 0.05
Keeley	Toronto	*45	*45	*45	Mr. 15, 1928 0.04
Mining Corp.	Toronto	4.00	3.75	3.75	My. 30, Je. 13 0.12½
Montana-Mines Corp.	Spokane	*50	*48	49½	
N. Y. & Hond. Ros.	N. Y. Curb			15½	Oc. 16, Oc. 26 QX 0.50
Nipissing	N. Y. Curb	2½	2	2	Se. 26, Oc. 21 Q 0.07½
Premier Gold	N. Y. Curb	1¼	1⅛	1⅛	Se. 12, Oc. 3 Q 0.06
Tonopah Exten.	N. Y. Curb			*10	April, 1925 0.05
Tonopah Mining	N. Y. Curb	2⅜	2⅜	2⅜	Se. 30, Oc. 21 0.07½
United Eastern	N. Y. Curb			*25	
Yukon Gold	N. Y. Curb	*68¾	*68¾	*68¾	June, 1918 0.02
IRON AND STEEL					
Bethlehem Steel	New York	120¾	111	111	Oc. 18, No. 15 Q 1.50
Beth. Steel, pfd, 7%...	New York	126	125½	125½	Se. 6, Oc. 1 Q 1.75
Cleveland-Cliffs	Cleveland	100	97	98	Se. 5, Se. 15 Q 1.00
Colo. Fuel & Iron	New York	63½	55	60	
Colo. F. & I., 1st pfd.	New York			126	Au. 10, Se. 26 Q 2.00
Great Northern Iron	New York	31½	29	29	Dec. 15 K 2.00
Inland Steel	New York	100	95	95	Au. 15, Se. 1 Q 1.87½
Republic I. & S.	New York	130¾	106	111	My. 11, Je. 1 Q 1.00
Republic I. & S. pfd.	New York	111½	111½	111½	Je. 12, Jl. 1 Q 1.75
Sloss-Sheffield S. & I.	New York	49½	49	49	Mr. 11, Mr. 20 Q 1.50
Sloss-Sheff. S.&I., pfd.	New York	72	71½	71½	Se. 20, Oc. 1 Q 1.50
U. S. Steel	New York	233½	208	209	Au. 29, Se. 28 Q 1.75
U. S. Steel, pfd.	New York	143	142	142	Au. 5, Au. 30 Q 1.75
Virginia I. C. & C.	New York	22	22	22	Jan., 1924 1.50
Virginia I.C.&C., pfd.	New York	43	41½	42	Jl. 16, 1928 SA 2.50
MISCELLANEOUS					
Aluminum Co. of Am.	N. Y. Curb	430	380	380	
Alum. Co. of Amer., pf.	N. Y. Curb	106½	106½	106½	Mr. 15, Ap. 1 Q 1.50
American Metal	New York	70	64¾	66	Au. 21, Se. 1 Q 0.75
Amer. Metal, pfd., 6%	New York			126½	Au. 21, Se. 3 Q 1.50
Amer. Sm. & Ref.	New York	115¼	105	106	Oc. 11, No. 1 Q 1.00
Amer. Sm. & Ref., pfd.	New York	137¼	135½	136½	No. 1, De. 2 Q 1.75
Ang. Ch. Nitrate	N. Y. Curb	37½	33	34½	
Asbestos Corp.	Montreal	4½	4¼	4½	Jan., 1926 1.50
Asbestos Corp., pfd.	Montreal	17	17	17	De. 31, Ja. 15 Q 1.75
Consol. M. & S.	Montreal	380½	375	375½	Je. 29, Jl. 15 SAX 6.25
De Beers Consol.	New York			21	Jl. 23, Jl. 26 Q 0.96
Federated Metals	N. Y. Curb	35	33½	33½	Oc. 3, Oc. 11 Q 0.25
Freeport Texas	New York	45¼	41¼	41¼	Oc. 15, No. 1 Q 1.00
Int. Nickel Can.	New York	55½	48¾	48¾	Au. 31, Se. 30 Q 0.25
Int. Nickel, pfd.	New York			120	Se. 28, No. 1 Q 1.75
Mayflower Assoc.	N. Y. Curb	98¾	92	94½	
Metal & Mining	N. Y. Curb	16½	16¼	16½	Se. 21, Oc. 1 0.30
Newmont	N. Y. Curb	219¾	204¾	204¾	Se. 30, Oc. 15 Q 1.00
Patino M. & E.	New York	38⅛	36	36⅜	Au. 31, Se. 28 A.s. 0.97
So. America G. & P.	N. Y. Curb	2½	2	2	
Texas Gulf Sulphur	New York	70¾	66	66½	Se. 2, Se. 16 Q 1.00
U. S. Sm. R. & M.	New York	50	45¼	45¼	Oc. 7, Oc. 15 Q 0.87½
U. S. Sm. R. & M., pfd	New York	53½	53¼	53¼	Oc. 7, Oc. 15 Q 0.87½
Vanadium Corp.	New York	84¾	76½	78¾	Nv. 1, Dc. 16 QX 1.75

Toronto Standard Stock Exchange, Toronto, courtesy the Arthur E. Moysey Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Standard Stock Exchange, Spokane, courtesy Pohlman Investment Company

*Cents per share. †Bid or asked. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I Initial. R, Respumption. X, Extra. The first date given is that of the closing of the books; the second that of the payment of the dividend. A.s., American shares.

LONDON QUOTATIONS—WEEK ENDED October 8, 1929

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	20/—	20/—	20/—		
Alaska Treadwell ($25)	60/—	60/—	60/—	Nov., 1926	4 p.c.
Aramayo Mines (25 frs.)	57/—	57/—	57/—	Aug., 1929	5 p.c.
Burma Corpn. (10 rupees)	18/1½	17/4½	17/9	July, 1929	9 annas*
Bwana M'Kubwa (5s)	27/9	25/6	26/6		
Camp Bird (2s)	2/4½	2/—	2/3	April, 1928	16⅔ p.c.
El Oro (5s)	2/9	2/9	2/9	Nov., 1924	2½ p.c.*
Frontino & Bolivia (£1)	6/10½	5/—	6/9	Jan., 1929	3⅓ p.c. (e)
Mexican Corpn. (£1)	16/3	14/10½	15/3	Oct., 1929	10 p.c.
Mexico Mines of El Oro (£1)	5/1½	5/—	5/—	Dec., 1926	3⅓ p.c.*
Mount Isa (£1)	36/3	34/9	35/—		
N'Changa Copper Mining (£1)	56/10½	51/7½	53/9		
Oroville Dredging (4s)	1/9	1/9	1/9	Nov., 1928	31¼ p.c.
Rhodesian Congo Border (£1)	180/—	170/—	177/6		
St. John del Rey (£1)	17/1½	15/10½	17/—	April, 1929	7½ p.c.
San Francisco Mines (10s)	36/4½	35/4½	36/4½	June, 1929	15 p.c.
Santa Gertrudis (£1)	10/7½	9/6	10/—	July, 1929	7½ p.c.
Selukwe (2s. 6d.)	6/9	5/7½	6/9	April, 1917	6¼ p.c.
S. Amer. Copper (2s)	2/9	2/4½	2/6	Nov., 1917	75 p.c.
Tanganyika (£1)	57/9	54/—	56/9	July, 1929	7½ p.c.
Union Miniere du Haut-Katanga (Brussels)	11,025	10,700	11,025	April, 1929	300 fr. (‡)

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian francs and free of taxation. e—on original £1 shares.